National Park Service
U.S. Department of the Interior

Denali National Park and Preserve
Alaska

Cantwell Subsistence Off-Road Vehicle Management Environmental Assessment
May 2007

Prepared by:
United States Department of the Interior
National Park Service
Denali National Park and Preserve

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Front Cover Photograph: The Bull River on the Western Boundary of the Cantwell Traditional Use Area (Photo by Rob Liebermann, Denali National Park and Preserve)

DEFINITIONS

17b Easement: Section 17b of the 1971 Alaska Native Claims Settlement Act (ANCSA) authorizes public transit rights ("easements") across lands selected by and conveyed to ANCSA Village and Regional Corporations for access to public lands.

Floodplains: Floodplains are land areas adjacent to rivers and streams that are subject to occasional or periodic flooding.

Aggressive Lugged Tire or Paddle Tire: An aggressive lugged tire is an ORV tire that has a centerline lug depth greater than 1 inch. A paddle tire is an ORV tire specifically designed for use in sand, though it could be used in mud, that consists of a smooth tire core which has a series of large rubber cups (or paddles) attached to it.

Cantwell Resident Zone: Regulations implementing the 1980 Alaska National Interest Lands Conservation Act (ANILCA) define a resident zone as "the area within, and the communities and areas near, a national park or monument in which persons who have customarily and traditionally engaged in subsistence uses within the national park or monument permanently reside" (36 CFR 13.42(b)). The Cantwell Resident Zone is defined as the area within a three-mile radius of the U.S. Post Office in Cantwell.

Curb Vehicle Weight: The weight of an ORV without driver, passengers, or cargo, but with all its standard equipment and full fuel, oil and coolant tanks.

Fall –Line: The straightest and steepest line down a slope.

Gross Vehicle Weight: The weight of an ORV with all its standard equipment and full fuel, oil and coolant tanks, as well as a driver, passengers, and cargo.

Maintainable Trail Segment: A "maintainable" trail segment is one that is not built with a specific set of design criteria in mind, but with appropriate and reasonable mitigation and maintenance, it will support a limited level of use without unacceptable environmental degradation or a decrease in travel surface utility.

NPS Qualified Subsistence User (for purposes of this EA): In the context of this EA, NPS qualified subsistence users are eligible subsistence users for Denali National Park and Preserve who comply with Federal subsistence regulations. In the ANILCA additions of Denali National Park this includes all people who: (1) are local rural Alaska residents *and* have a positive customary and traditional use determination for the species and wildlife in the management unit where they want to hunt *and* who permanently reside in the Denali National Park resident zone (i.e., are residents of the park, Cantwell, Nikolai, Minchumina, or Telida); or (2) are local rural Alaska residents who have been issued a 13.44 subsistence use permit by the superintendent of Denali National Park and Preserve.

Off-Road Vehicle: Any motor vehicle designed for or capable of cross-country travel on or immediately over land, water, snow, ice, marsh, wetlands, or other natural terrain, except snow machines or snowmobiles [as defined in 36 CFR 13.1(l).].

Ordinary High Water Mark: Per the Alaska Department of Natural Resources, the "portion of the bed(s) and banks, up to the ordinary high water mark" means (1) in the non-tidal portion of a

river, lake, or stream: the portion of the bed(s) and banks up to which the presence and action of the non-tidal water is so common and usual, and so long continued in all ordinary years, as to leave a natural line or "mark" impressed on the bank or shore and indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, or other distinctive physical characteristics; (2) in a braided river, lake, or stream: the area delimited by the natural line or "mark," as defined in Part 1 above, impressed on the bank or shore of the outside margin of the most distant channels; or (3) in the tidally influenced portion of a river, lake, or stream: the portion of the bed(s) and banks below the mean high water elevation.

Pass: A narrow linear delimited surface area showing ground disturbance resulting from the single passage of an ORV.

Route: A delimited surface area used for passage of ORVs between two points, and without a visible, traceable travelway.

Sustainable Trail Segment. A “sustainable” trail segment is one that meets a specific set of design criteria formulated to provide a high level of environmental protection and long-term utility of the tread surface under all anticipated use levels and climatic conditions; *and* receives regular maintenance to remain within its original design specifications.

Trail: A narrow linear delimited surface area showing ground disturbance resulting from multiple repeated passage of an ORV.

Trail Segment: A section of a trail that displays a given set of physical characteristics as documented through a trail condition assessment process. A trail between point A and point B would normally have a series of individual trail segments of varying lengths displaying unique physical characteristics such as trail width, amount of soil compaction, etc.

ORGANIZATION OF THIS ENVIRONMENTAL ASSESSMENT

This EA is organized into five chapters and five appendices and has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969 and regulations of the Council on Environmental Quality (40 CFR 1508.9). The major sections of this EA are:

- **Executive Summary** – Summarizes the purpose and need, alternatives, and environmental consequences of the alternatives.
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- **Chapter 1: Purpose and Need for Action** – Provides introductory material that explains the purpose and need for action, provides background information about the project area, pertinent laws and regulations, and describes the issues and impact topics to be addressed.

- **Chapter 2: Alternatives** – Describes the No Action Alternative and three action alternatives. Summary comparisons of the alternatives and of their environmental effects also are provided in two tables at the end of this chapter.

- **Chapter 3: Affected Environment** – Describes the existing environment for each of the specific resources and other impact topics being analyzed.

- **Chapter 4: Environmental Consequences** – Describes the direct, indirect, and cumulative effects likely to occur with implementation of each alternative.

- **Chapter 5: Consultation and Coordination** – Describes the public involvement process for the EA, including discussions with local, state, and federal agencies, as well as organizations and individuals.

- **Appendices**
  Appendix 1: ANILCA Section 810(A): Summary of Evaluations and Findings
  Appendix 2: Monitoring Strategies for Management Alternatives
  Appendix 3: Implementation Cost Estimates for Management Alternatives
  Appendix 4: Draft Best Management Practices Framework
  Appendix 5: Trail Management Prescriptions
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EXECUTIVE SUMMARY

The National Park Service (NPS) is considering alternatives for managing subsistence-related off-road vehicle use in the Cantwell Traditional ORV Use Area (TUA) of Denali National Park and Preserve (see Figure 1.1). In this environmental assessment (EA), the NPS analyzes four management alternatives and their impacts on the environment.

Purpose of Action

In July 2005, the NPS published the final "Cantwell Subsistence Traditionally Employed Off-Road Vehicle Determination" which opened the entire 32,159 acre Cantwell traditional ORV use area (TUA) to the use of off-road vehicles (ORVs), for subsistence purposes by NPS qualified subsistence users. The NPS is proposing this current action to assure subsistence ORV use in this area is proactively managed to minimize adverse impacts to the resources and values for which the park was established while also providing reasonable access for subsistence purposes. Along with the 2005 Determination, this action would amend the General Management Plan for Denali (GMP).

Need for Action

The 1980 Alaska National Interest Lands Conservation Act (ANILCA) authorizes subsistence uses where traditional in the ANILCA additions of Denali National Park (Denali park additions) by local rural residents. ANILCA also provides for reasonable access with methods of surface transportation traditionally used for subsistence purposes.

The NPS determined in the 1986 Denali General Management Plan (GMP) that ORVs had not been regularly used for subsistence purposes and were not considered a traditional means of subsistence access. The GMP determination was based on existing information and applied on a park-wide basis. However, the GMP also provided that in the future, as additional information became available, the park would review traditional means of subsistence access on a case by case basis.

In the 1990's, eight Cantwell subsistence users and the Denali Subsistence Resource Commission (SRC) requested that the Superintendent review and reconsider the 1986 GMP determination in light of new information provided by Cantwell residents regarding their traditional use of ORVs for access to subsistence resources. Specifically, in a September 29, 1996 letter to the NPS, the Denali SRC made the following recommendation:

> "Access should be allowed at the same level as 1980, with reasonable allowances for restrictions to preserve the environment. At Denali for instance, people in the Cantwell resident zone have used ORVs traditionally; an examination of access routes suggests that in some areas, because of lack of vegetation and presence of a harder, less-eroding surface, ORV use for retrieval of moose meat from

> subsistence hunting should be permitted. It is understood that the situation would be monitored and if a detrimental change to the environment should result from ORV use, the permission to use ORVs would be suspended. It was also suggested that a trial period, perhaps of one hunting season, with restrictions (to mapped routes, etc.), be opened to determine the advisability of continuing the ORV use."

In response to these requests, and in compliance with ANILCA and NPS regulations and policies, the NPS undertook a project to compile and review traditional access information for the Cantwell area. The scope of this review and report was limited to the Cantwell area because the request was specific to that community and adjacent Denali National Park lands regarding traditional subsistence ORV access for the Cantwell area.

On July 22, 2005, the NPS published a final "Cantwell Subsistence Traditionally Employed ORV Determination" (NPS 2005d) in which it determined that the community of Cantwell had used ORVs for successive generations for subsistence purposes in portions of the Denali Park additions before the establishment of the Denali National Monument in 1978 (again, see Figure 1.1). Such use is subject to the provisions of 36 CFR 13.46, 50 CFR Part 100, and other applicable laws and regulations (see "Laws, Regulations, and Policies" for more information).

In both August 2005 and August 2006, the NPS implemented a temporary 120-day closure to protect park resources in the area where Cantwell residents traditionally employed ORVs for subsistence purposes that was identified in the Determination. To allow ORV access for subsistence, three existing trails were exempted from the closure: the 1) the one mile long Windy Creek Trail from the park boundary to the top of the ravine leading down to Windy Creek, including the 0.5 mile long spur trail that leads to the west/southwest from the ravine. 2) the northern portion of the old roadbed that extends southwest from the Cantwell Airstrip, for approximately one mile to the top of a little knoll, and 3) the Cantwell Creek Trail, which encompasses the gravelly part of the floodplain of Cantwell Creek for about 3 1/4 miles within the park downstream of the wilderness boundary, including the section that re-enters the park near Pyramid Peak. (See Figure 1.2.)

The closure allowed reasonable access to subsistence resources for NPS qualified subsistence users while protecting park resources and also giving the NPS time to complete the necessary field work and environmental documentation evaluating ORV effects on park resources and values. The necessary field work has been completed and the environmental documentation is presented in this EA.

Impact Topics Evaluated

To focus the environmental assessment, the NPS selected the following impact topics for further analysis:

- Soils
- Vegetation, Including Wetlands

- Wildlife,
- Water Resources
- Visitor Experience
- Wilderness
- Subsistence Opportunities

Alternatives

Four alternatives for managing subsistence ORV use in the 32,159 acre Cantwell Traditional Use Area (TUA) were considered (see Table 2.3, in Chapter 2, Alternatives). Management alternatives were developed with input from the State of Alaska, the Denali Subsistence Resources Commission and other members of the public.

The four alternatives evaluated were:

Alternative 1 (No Action). Under this alternative, the TUA would remain open to ORV use by NPS qualified subsistence users for all subsistence purposes. This No Action Alternative is a required alternative under the 1969 National Environmental Policy Act.

Alternative 2. Under this alternative, the TUA would remain open to off-trail ORV use by NPS qualified subsistence users only by permit for retrieval of subsistence harvested moose or caribou. ORV use for all subsistence purposes would be authorized on the new Bull River Access Trail and on several NPS-managed existing trails and routes (the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, the Upper Cantwell Creek Floodplain Trail/Route, and the Bull River Floodplain Trail/Route). Certain closures would apply.

Alternative 3. Under this alternative, ORV use for all subsistence purposes would be authorized *only* on the new Bull River Access Trail and on several NPS-managed existing trails and routes (the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, the Upper Cantwell Creek Floodplain Trail/Route, and the Bull River Floodplain Trail/Route). Certain closures would apply. A winter subsistence moose hunt would be possible.

Alternative 4. This alternative would be the same as Alternative 3, except the NPS would not construct the new Bull River Access Trail or allow ORV use on either the Bull River Floodplain or the Upper Cantwell Creek Floodplain. The NPS would authorize ORV use for subsistence purposes on NPS-managed trails *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons.

Environmental Consequences

Following the alternatives is an analysis of the environmental consequences of the actions in each alternative. This analysis evaluates the magnitude of impacts and how these impacts compare to current conditions. The cumulative impact assessment outlines

overall impacts resulting from past, current, propose, and reasonably foreseeable future management and other actions. The analysis is intended to guide the decision-maker in choosing a management action based on an objective understanding of environmental consequences.

These environmental consequences are analyzed in Chapter 4 and summarized in Table 2.4, which appears at the end of Chapter 2. Conclusions for each alternative may be stated as follows.

Alternative 1 (No Action)

Unlimited ORV use for subsistence purposes across the Traditional Use Area would result in moderate to major adverse impacts to most of the topics analyzed (the exception being water resources for which minor adverse impacts are predicted). Most affected would be soils, vegetation, wildlife, wilderness, subsistence opportunities, and park operations. For soils and vegetation, major impacts would be widespread and difficult to predict, but over the long term could result in degradation on significant areas within the 32,159 acre TUA, with most impacts occurring on 2,900 acres of flat and open terrain. There would be major adverse impacts on moose in the Cantwell TUA because levels of harvest would increase dramatically over the current average. Alternative 1 would cause major adverse impacts on wilderness resources because the lack of proactive management would result in two important wilderness resource values, presence of natural conditions and opportunities for solitude, being compromised by the perpetuation of existing damage and the expansion of many miles of new ORV trails throughout the TUA. The level of these adverse impacts would necessitate the re-designation of the current status of the TUA from eligible for wilderness designation to one of ineligible. Actions in this alternative would have major negative impacts on subsistence opportunities because subsistence moose hunting, facilitated by unrestricted ORV access, would be above a sustainable level in the TUA. The level of impacts to subsistence anticipated from this alternative would eventually result in a significant restriction to subsistence resources (primarily moose).

The major adverse impacts on soils, vegetation, wildlife, and wilderness would lead to impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

Alternative 2

Limited ORV use for subsistence purposes both off-trail and on NPS-managed trails and routes in the Traditional Use Area would result in minor to major adverse impacts to the topics analyzed. Soils, wildlife, water resources, and visitor experience would all be adversely impacted to a minor to moderate degree under this alternative. Actions in this alternative would have a major impact on vegetation (including wetlands) and wilderness in the Cantwell TUA because of widespread long-term ORV use in many areas of the TUA.

There would be minor beneficial effects to subsistence resources and opportunities because of extensive ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years.

Were impacts on vegetation (including wetlands) to reach the upper levels, these impacts would result in impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

Alternative 3

Limited ORV use for subsistence purposes only on NPS-managed trails and routes in the Traditional Use Area, plus a possible winter subsistence moose hunt, would result in moderate adverse impacts on soils, vegetation, wildlife, and wilderness. Water resources and visitor experience would be subject to minor to moderate adverse impacts.

There would be minor beneficial effects to subsistence resources and opportunities because of improved ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years.

Alternative 3 would not cause impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

Alternative 4

Alternative 4 would allow for the most limited ORV use for subsistence purposes in the TUA. This alternative would have negligible to minor adverse impacts on soils, vegetation, wildlife, water resources, and visitor experience. There also would be minor adverse impacts on subsistence opportunities, primarily because access would be more difficult (however, a winter hunt would provide additional subsistence opportunities).

The actions in this alternative would result in overall moderate benefits to wilderness resource values, largely due to the elimination of ORV trails, routes, and dispersed ORV travel. There would be major improvements to the presence of natural conditions and solitude due to the recovery of large areas of impact and a reduced scope of motorized use.

Alternative 4 would not cause impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

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1.0 PURPOSE AND NEED FOR ACTION

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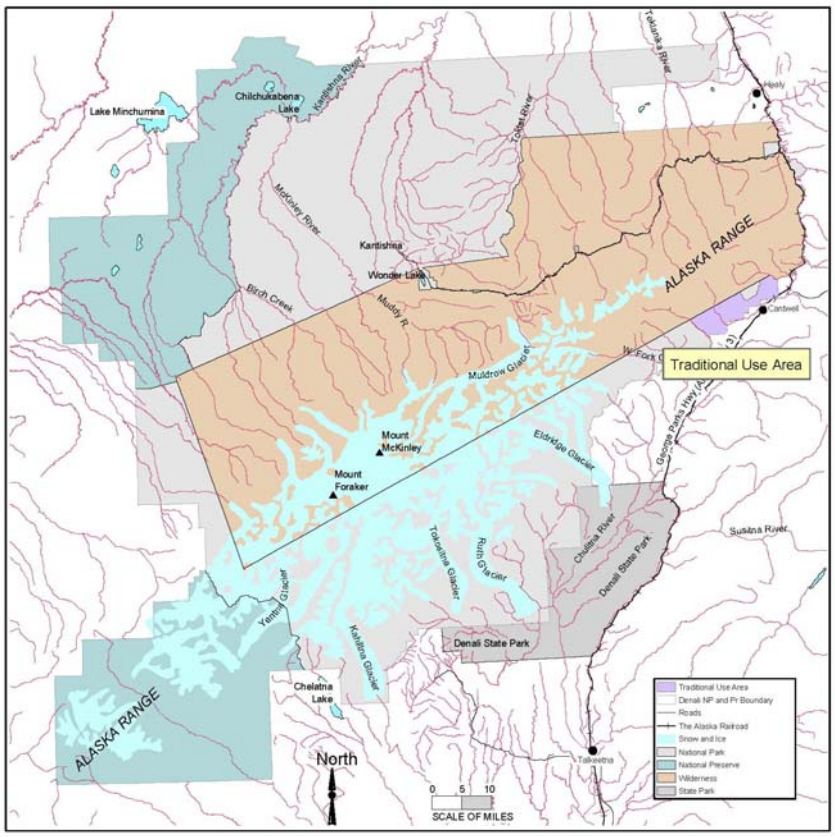

Figure 1.1 Project Location

Denali National Park and Preserve
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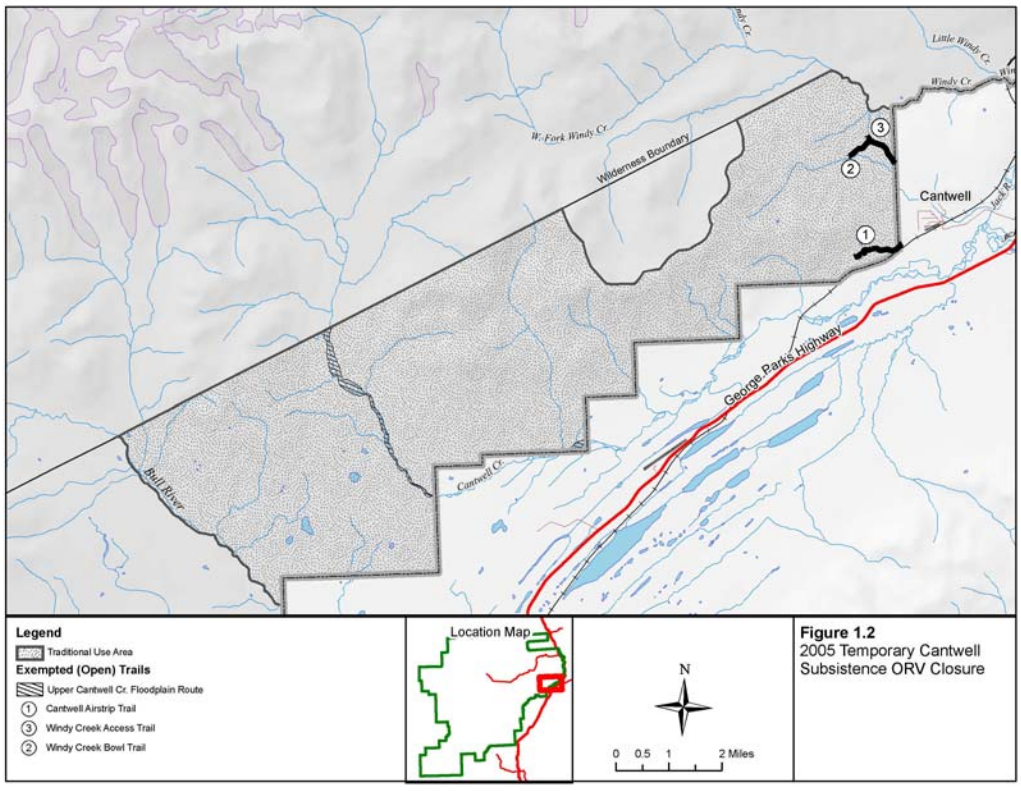

Figure 1.2
2005 Temporary Cantwell Subsistence ORV Closure

1.3 PARK PURPOSE

The purposes for which Denali National Park and Preserve was created are found in the language of the 1980 Alaska National Interest Lands Conservation Act (ANILCA, Pub. L. 96-487), that enlarged and renamed the park Denali National Park and Preserve. Section 202 (3) (a) of ANILCA stated that the Denali National Park and Preserve additions are to be managed for the following specific purposes:

- To protect and interpret the entire mountain massif and the additional scenic mountain peaks and formations.

- To protect habitat for, and populations of fish and wildlife, including, but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans, and other waterfowl.

- To provide continued opportunities, including reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities.

1.4 PARK SIGNIFICANCE

Statements of park significance define what is most important about the park's resources and values and are based on the purpose of why the park was created. These statements capture the attributes that make the park's resources and values important enough for Congress and the president to establish it as a unit of the National Park System. The 2006 *Denali National Park and Preserve Backcountry Management Plan* provides detailed park significance statements; these are abbreviated as follows:

Large Protected Area. The six million acres of the Park and Preserve enables a spectacular array of flora and fauna to live together in a healthy natural ecosystem and provides excellent opportunities to study subarctic ecosystems in settings largely undisturbed by humans.

Mountains and Glaciers. The park contains a major portion of the Alaska Range, one of the great mountain uplifts in North America, including North America's highest peak, Mount McKinley and some of the largest glaciers in North America.

Wildlife and Habitat. While populations fluctuate, nowhere else in America can such concentrations of these large species of wildlife be observed in as accessible a natural setting. The park is also significant for its diverse avian habitat and rich and varied vegetation. Denali has more than 10,000 mapped lakes.

Scenic Resources and Air Quality. Outstanding views of natural features, including mountains, glaciers, faults, and rivers dominate the park landscape. Denali National Park and Preserve is a designated Class I airshed under the Clean Air Act Amendments.

Cultural Resources. There are 257 known cultural resource sites within Denali's boundaries, including both prehistoric and historic sites. Because cultural resource inventories have been limited to date, this number likely represents a small fraction of the park's total sites.

Mountaineering. Mount McKinley is considered one of the world's premier mountaineering destinations, drawing climbers from many countries. Many other peaks in the park, including Mount Foraker, also offer outstanding expeditionary climbing opportunities.

Wilderness Recreation. Denali offers superlative opportunities for primitive wilderness recreation. This huge park contains large areas with almost no trails and where evidence of human use is minimal to nonexistent. A large portion of Denali's backcountry is readily accessible to visitors who can reach the park by either highway or railroad from either Anchorage or Fairbanks.

1.5 LAWS, REGULATIONS, AND POLICIES

1.5.1 General Direction for Public Enjoyment and Resource Protection

The National Park Service Organic Act of 1916 (16 USC §§ 1-4, 39 Stat. 535)
The Organic Act establishes the National Park Service and directs the agency to

> … promote and regulate the use of the Federal areas known as national parks, monuments, and reservations… by such means and measures as conform to the fundamental purpose of the said parks, monuments and reservations, which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.

Importantly for all planning processes in the park system, the Organic Act provides a fundamental standard for management – that park resources should remain "unimpaired" for the enjoyment of future generations.

Redwood National Park Expansion Act of 1978 (16 USC §§ 1-1a, 92 Statute 166)
The Redwoods Act amends the Organic Act and clarifies the importance Congress placed on protecting park resources such that:

> The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress.

NPS Management Policies Section 1.4. The NPS Management Policies use the terms "resources" and "values" to mean the full spectrum of attributes for which a park unit is established and managed, including the Organic Act's fundamental purpose and any additional purposes as stated in a park unit's establishing legislation. The impairment of park resources and values may not be allowed unless directly and specifically provided by statute. The primary responsibility of the National Park Service is to ensure that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities to enjoy them.

The evaluation of whether impacts of a proposed action would lead to impairment of park resources and values is included in the environmental consequences chapter of this document. Impairment is more likely when there are potential impacts to a resource or value whose conservation is

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park; or
- identified as a goal in the park's general management plan or other relevant NPS planning documents.

1.5.2 Subsistence Management

Although not a specific purpose of Denali National Park and Preserve, the NPS manages the park additions for subsistence use in accordance with ANILCA. The following laws and regulations govern this use.

ANILCA Section 202(3)(a) [16 USC §410hh-l]. This section is specific to Denali National Park and Preserve and directs that "subsistence uses by local residents shall be permitted in the additions to the park where such uses are traditional in accordance with the provisions in title VIII."

ANILCA Section 810 [16 USC §3120]. This section provides that "in determining whether to....permit the use, occupancy, or disposition of public lands under any provision of law authorizing such actions, the head of the Federal agency having primary jurisdiction over such lands or his designee shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands of the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes." The ANILCA 810 Evaluation for this project is found in Appendix 1 of this document.

ANILCA Section 811 [16 USC § 3121(b)]. This section provides for continued access to public lands for subsistence use. Specifically, it states that ". . . rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands" and "Notwithstanding any other provision of this Act or other law, the Secretary [of Interior] shall permit on the public lands appropriate use for subsistence purposes of snowmachines, motorboats *and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulations*" (italics added).

36 CFR § 13.460. This regulation implements ANILCA Section 811(b). It authorizes the use of snowmobiles, motorboats, dog teams and other means of surface transportation traditionally employed by local rural residents engaged in subsistence uses within park areas except at those times and in those areas restricted or closed by the Superintendent. Subsection (b) of this regulation allows a Superintendent to restrict or close a route or area to ORVs if determined that "such use is causing or is likely to cause an adverse impact on public health and safety, resource protection, protection of historic or scientific values, subsistence uses, conservation of endangered or threatened species, or the purposes for which the park area was established." Subsection (c) requires a notice and public hearing in the affected vicinity prior to imposing restrictions or closures. Subsection (d) directs that surface transportation, including ORVs, traditionally employed by local rural residents engaged in subsistence uses be operated in such manner as to prevent waste or damage to the parks, and in such a manner as to prevent the herding, harassment, hazing or driving of wildlife for hunting or other purposes.

36 CFR Part 13 (Subpart B). These regulations implement the NPS subsistence management program.

50 CFR Part 100. These regulations implement the Federal Subsistence Management Program on public lands within the State of Alaska, including the park additions, and outline a process to identify NPS qualified subsistence users (see also definition at beginning of EA).

1.5.3 Wilderness Management

The GMP identified the park land within the present-day Cantwell traditional ORV use area as suitable (hence referred to as eligible) for designation as wilderness. This eligible wilderness is managed according to the following laws and policies.

The Wilderness Act of 1964 (16 USC §§ 1131-1136, 78 Stat. 890). The 1964 Wilderness Act established the National Wilderness Preservation System and defined wilderness as follows:

> A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this chapter an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which
>
> (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;
> (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation;
> (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and
> (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.

Alaska National Interest Lands Conservation Act of 1980 (ANILCA, 16 USC §§ 3101-3233). ANILCA provides guidance about wilderness management at Denali.

- ANILCA Section 101 lists “preserve wilderness resource values” as a fundamental purpose of ANILCA.
- ANILCA Section 102(13), states that the term “wilderness” as used in ANILCA has the same definition as in the Wilderness Act.
- ANILCA Section 203(a) states that a fundamental purpose of the Denali park and preserve additions is to provide continued opportunities, including reasonable access, for wilderness recreational activities.
- ANILCA Section 1317 requires a wilderness suitability review and wilderness recommendations regarding the park additions and preserve lands added to Denali by ANILCA.

In addition, ANILCA provides some exceptions to national park and wilderness management practice, including allowing appropriate use for subsistence purposes of other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulations (see ANILCA Section 811 above).

NPS Management Policies, Chapter 6. Section 6.3.1 establishes that eligible and proposed wilderness on NPS lands should be managed under wilderness policy.

> For the purposes of applying these policies, the term “wilderness” will include the categories of eligible, study, proposed, recommended, and designated wilderness. Potential wilderness may be a subset of any of these five categories. The policies apply regardless of category except as otherwise provided herein.

> In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved. This policy will be applied to all planning documents affecting wilderness.
>
> The National Park Service will take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed. Until that time, management decisions will be made in expectation of eventual wilderness designation. This policy also applies to potential wilderness, requiring it to be managed as wilderness to the extent that existing nonconforming conditions allow. The National Park Service will apply the principles of civic engagement and cooperative conservation as it determines the most appropriate means of removing the temporary, nonconforming conditions that preclude wilderness designation from potential wilderness. All management decisions affecting wilderness will further apply the concept of "minimum requirement" for the administration of the area regardless of wilderness category. The only exception is for areas that have been found eligible, but for which, after completion of a wilderness study, the Service has not proposed wilderness designation. However, those lands will still be managed to preserve their eligibility for designation.

1.6 RELATIONSHIP OF PROJECT TO OTHER DOCUMENTS, PROVISIONS, AND PLANNING

1986 Denali National Park and Preserve General Management Plan. In terms of motorized subsistence uses, the GMP determined that ORVs had not been regularly used for subsistence purposes and were not considered a traditional means of subsistence access. This determination was made on existing information and applied on a park-wide basis. The GMP also provided that in the future as additional information became available the park will review traditional means of subsistence access on a case by case basis.

2004 Denali National Park Subsistence Management Plan. Subsistence management for Denali National Park and Preserve is addressed in the 2004 Subsistence Management Plan, which was prepared in cooperation with the Denali Subsistence Resource Commission. Specific to ORVs, the plan states:

> ORV's are generally not permitted for subsistence within NPS lands, but their use may be permitted in specific areas if such vehicles were traditionally employed for subsistence purposes in those specific areas. In such cases ORV use may only occur on designated trails where it has been determined that their use will not adversely affect the natural, aesthetic or scenic values of the park lands. There are no designated trails or routes identified at this time in Denali National Park and Preserve.

Relative to the specific topic of this EA, the plan recommended:

> SRC Actions: (1) Designate ATV routes into the park for use by residents of Cantwell for subsistence moose and caribou hunting. (2) Allow access to Denali at the same level as 1980, with reasonable restrictions to preserve the environment.
>
> NPS Actions: Define "traditionally employed."

2005 Cantwell Subsistence Traditionally Employed ORV Final Determination. This determination concluded that the community of Cantwell had used ORVs for successive generations for subsistence purposes in portions of the Denali Park additions before the establishment of the Denali National Monument in 1978.

2006 Denali National Park and Preserve Backcountry Management Plan. This plan amended the GMP and designated the land within the present-day Cantwell traditional ORV use area (TUA) as Management Area B. The purpose of the Management Area B zone is to provide opportunities for wilderness recreational activities suitable for day users and overnight users that are remote and require self-reliance.

17B Easement Across Ahtna, Incorporated Property Near Cantwell. This is an easement for an existing access trail twenty-five (25) feet in width from the Cantwell Airport in Sec. 31, T. 17S, R.7W., Fairbanks Meridian, northwesterly across Ahtna Incorporated property to the Denali National Park boundary. The public uses allowed on the trail easement are: travel by foot, dogsleds, animals, snowmobiles, two- and three-wheel vehicles, and small all-terrain vehicles (ATVs) (less than 3,000 pounds gross vehicle weight).

1.7 IMPACT TOPICS

To focus the environmental assessment, the NPS selected specific impact topics for further analysis and eliminated others from evaluation.

1.7.1 Impact Topics Selected for Detailed Analysis

Soils. ORV use causes soil rutting, displacement, and compaction. This causes soil loss or reduced productivity.

Vegetation, Including Wetlands. ORVs can directly impact vegetation, including wetlands, by crushing plants, scarring trees, and exposing roots. Sites disturbed by ORVs may be susceptible to invasive plants. All of these could result in changes in plant composition. In addition, the construction of ORV trails results in the loss of vegetation.

Wildlife. ORV use could result in displacement and disturbance of moose and wolves.

Water Resources. ORV use across wetlands or streams may increase sedimentation, potentially affecting water quality, stream morphology (shape), benthic invertebrates, and fish habitat and populations in and downstream of the TUA.

Visitor Experience. ORV use and its impact on vegetation and soils could impact the scenic quality of areas used by backpackers and visitors on scenic air tours. ORV use could also affect natural sounds, and viewing opportunities for wildlife.

Wilderness. ORV use could indirectly impact adjacent designated park wilderness and directly affect lands considered eligible for wilderness designation.

Subsistence Opportunities. Decisions made in this EA could affect subsistence opportunities, as well as the socio-economic conditions of NPS-qualified subsistence users.

1.7.2 Impact Topics Dismissed from Detailed Analysis

Floodplains. NPS Directors Order #77-2 (Floodplain Management) implements Executive Order 11988 ("Protection of Floodplains"). These guidelines direct the NPS to protect floodplains by avoiding actions that could adversely affect floodplains or increase flood risks. Although ORVs would be allowed on the Upper Cantwell Creek and Bull River Floodplains under some of the alternatives, such use is expected to have negligible impacts on floodplain functions (impacts to specific floodplain features such as vegetation and soils are covered separately under those headings). None of the alternative actions would occur in high-hazard areas. For these reasons, a Floodplain Statement of Findings to evaluate impacts to floodplains is not required.

Threatened and Endangered Species. No federally designated or candidate threatened or endangered animal or bird species are known to occur within Denali National Park and Preserve (USFW 2007a), and none are anticipated to be affected by the proposed project. No species proposed for listing occur in park and preserve, nor is there critical habitat. No federally-listed endangered or threatened plant species are known from the TUA (NPS 2004b, NPS 2004c).

Rare or Unique Plant Species. The following plant species, which have been designated as rare in Alaska have been found in the general vicinity of the Cantwell TUA: *Aphragmus eschscholtzianus, Botrychium alaskaense, Draba ruaxes, Minuartia biflora,* and *Oxytropis huddlesonii*. All of these taxa, except for *B. alaskaense*, generally occur in steeply sloping alpine areas, and thus are not considered to be imperiled by ORV activities. (Impacts to *B. alaskaense* are analyzed under the impact topic, "Vegetation, Including Wetlands.")

Air Quality. Denali National Park and Preserve has been designated a Class I area under the Clean Air Act. Fugitive dust and exhaust emissions would be produced by ORV use but would not cause national ambient air quality standards to be exceeded.

Water Pollution. ORV use may result in small amounts of petroleum products leaking into streams or wetlands, but the amounts are expected to be small and localized; therefore, impacts to water quality would be negligible.

Caribou. Patterns of caribou hunting would change less than they would for moose because retrieval of caribou isn't as dependent on mechanized transport (caribou are smaller so they are easier to pack out) and because caribou are more widely and unpredictably distributed. While moose tend to occur along river corridors (and near the trails), caribou tend to occur sporadically throughout the TUA. Hunting caribou is more opportunistic and, therefore, less effected by actions in this plan. The total number of caribou harvested in the TUA would likely be about the same as in the past (approximately 4 caribou/year) in all action alternatives and in alternative 1 (no-action) it would potentially double. Caribou populations would not be likely to be affected the same way as moose, because caribou move in and out of the TUA, and the 100-200 individuals that spend time in the TUA are only a small subset of the two herds (Denali and Nelchina), which number about 2,000 and 34,000 caribou, respectively. A harvest of 4 caribou per year (or even 8 caribou per year) isn't likely to have a significant effect on those herds (NPS 2006b, NPS 2006a). Also in all action alternatives, the NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for caribou to maintain natural and healthy populations on park land within the TUA

Cultural Resources. Ethnographic resources, cultural landscapes, historic structures, and archeological resources were dismissed from detailed analysis for the reasons listed below. Should additional cultural resources be discovered or uncovered during subsistence use activities, uses would be directed to notify the park superintendent

1. Ethnographic Resources: Per NPS-28 (Cultural Resource Management Guideline), ethnographic resources are traditional sites, structures, objects, landscapes, natural resources, and other material features associated with cultural systems or ways of life (also see http://www.cr.nps.gov/ethnography/parks/ resources/index.htm). Many ethnographic resources have been identified in Denali in various publications, including Haynes et al. 2001, Schneider et al. 1984, Gudgel-Holmes 1991, and Kari 2000. However, within the TUA there are not yet any traditional cultural properties identified. While there could be impacts identified in the future (e.g., disruption of traditional camp site, etc.), no more than minor impacts are expected.

2. Cultural Landscapes: Four Cultural Landscapes have been identified in Denali. The Headquarters Historic District is the only one listed on the National Register of Historic Places and is not in the backcountry. The other three cultural landscapes have not been inventoried, boundaries defined, or significance determined, but none are present in the TUA.

3. Historic Structures: In the backcountry of Denali the historic structures consist mainly of isolated patrol cabins, trapping cabins, and resources related to mining in the Kantishna and Dunkle Hills areas. The resources in the Dunkle Hills area were determined ineligible for the National Register. There are no historic structures within the TUA.

4. Archeological Resources: Denali National Park and Preserve is home to a host of cultural resources that date back to the earliest period of human settlement of North America. Many of these resources are from prehistoric time periods – archeological investigations conducted within and immediately adjacent to the park strongly suggest that sites dating from the Paleoarctic tradition (11,000 years before present) through the Protohistoric period (200 years before present) exist within the park. Throughout the park there are 257 known cultural sites and complexes representing Denali's rich cultural history.

   Currently, there is one known prehistoric site located in the TUA. An archeological survey of landforms for archeological resources was conducted within the TUA in August 2006. No archeological resources were discovered and the general areas of use within the TUA were considered low probability areas for significant archeological resources. Impacts to the potential archeological resources would be low.

   When specific actions are undertaken within any alternative (including the no action alternative) further analysis will be required to comply with the requirements of Section 106 of the National Historic Preservation Act (NHPA) in accordance with the Advisory Council on Historic Preservation's regulation implementing Section 106 (36 CFR Part 800, "Protection of Historic Properties". In addition, monitoring of existing and future trails will be conducted, and if currently unknown archeological resources are discovered, mitigation of the impacts to those resources will be undertaken.

Environmental Justice. Executive Order 12898 requires all federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects on minorities and low-income populations

and communities. The EO defines a minority population as either (a) the minority population of the affected area exceeds 50% or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. The EO states that low-income populations within an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the census' Current Population Reports, Series P-60 on Income and Poverty. In 2000, the estimated population of Alaska Natives in Cantwell was 41, or 19% of the total population. The average household income, derived from all sources, was $39,184, while the average earned income was $27,883 (ADFG 2002). Given this information, none of the alternatives would have disproportionately high impacts on minorities or low-income populations or communities. Therefore, environmental justice was eliminated from detailed analysis.

1.8 PERMITS AND APPROVALS NEEDED TO IMPLEMENT THE PROJECT

1.8.1 Wetlands

NPS Director's Order #77-1 (Wetland Protection) establishes the policies, requirements, and standards under which the NPS will meet its responsibilities to protect and preserve wetlands in a manner consistent with Executive Order 11990 ("Protection of Wetlands") and with the "no net loss of wetlands" goal as stated in the 1993 White House Office on Environmental Policy paper titled "Protecting America's Wetlands: A Fair, Flexible, and Effective Approach." Based on these guidelines, an NPS Wetlands Statement of Findings (SOF) evaluating wetlands impacts and prescribing mitigation measures and compensation efforts may be required depending on the alternative selected for implementation.

Again, depending on the alternative selected for implementation, the relationship of the wetlands to navigable waters, and the amount of wetlands impacted, a Corps of Engineers Clean Water Act Section 404 Permit may be needed. Additionally, the Alaska Department of Environmental Conservation may need to issue a Certificate of Reasonable Assurance pursuant to the Clean Water Act Section 401.

2.0 ALTERNATIVES

2.1 INTRODUCTION

This chapter describes several alternatives for managing subsistence ORV use in the 32,159 acre Cantwell Traditional Use Area (TUA). Also discussed are alternatives and actions that have been considered but dismissed from further analysis.

Though the NPS' goal is to implement the plan within 1 to 4 years, funding for implementation is not guaranteed. The plan would establish a vision for the future that would guide year to year ORV management of the Cantwell Traditional Use Area, but full implementation could be many years in the future.

While the NPS would bear the responsibility for directing and managing construction, improvement, and maintenance of any proposed ORV trails or routes, the subsistence ORV users themselves would be encouraged to engage in a cooperative effort with the NPS to provide labor and equipment for a significant portion of this work.

Management alternatives for the TUA were developed with input from the State of Alaska, the Denali Subsistence Resources Commission and other members of the public (see Chapter 5, Consultation and Coordination). The No Action Alternative (Alternative 1) is a required alternative under the 1969 National Environmental Policy Act and provides a baseline for analysis. The No Action Alternative and the action alternatives provide a reasonable range of management options.

The following topics are discussed for each alternative:

- ORV Use Off-Trail
- ORV Use On Trails
- ORV Use on the Bull River and Upper Cantwell Creek Floodplains
- Closures
- Harvest Limits
- Degradation Levels
- Zoning
- The 17B Easement

In addition to the above topics, monitoring strategies and implementation cost estimates have been developed for each alternative. These are found in Appendix 2 and 3, respectively.

At the end of this chapter, Table 2.4 summarizes the components and attributes of each alternative. Table 2.5 summarizes the predicted impacts for each alternative on the topics of concern.

2.2 ALTERNATIVE 1 (NO ACTION)

Under the No Action Alternative, the NPS would not undertake any new actions to manage subsistence ORV use (see Figure 2.1). NPS qualified subsistence users would continue to employ ORVs for subsistence purposes throughout the TUA. This alternative provides a baseline for

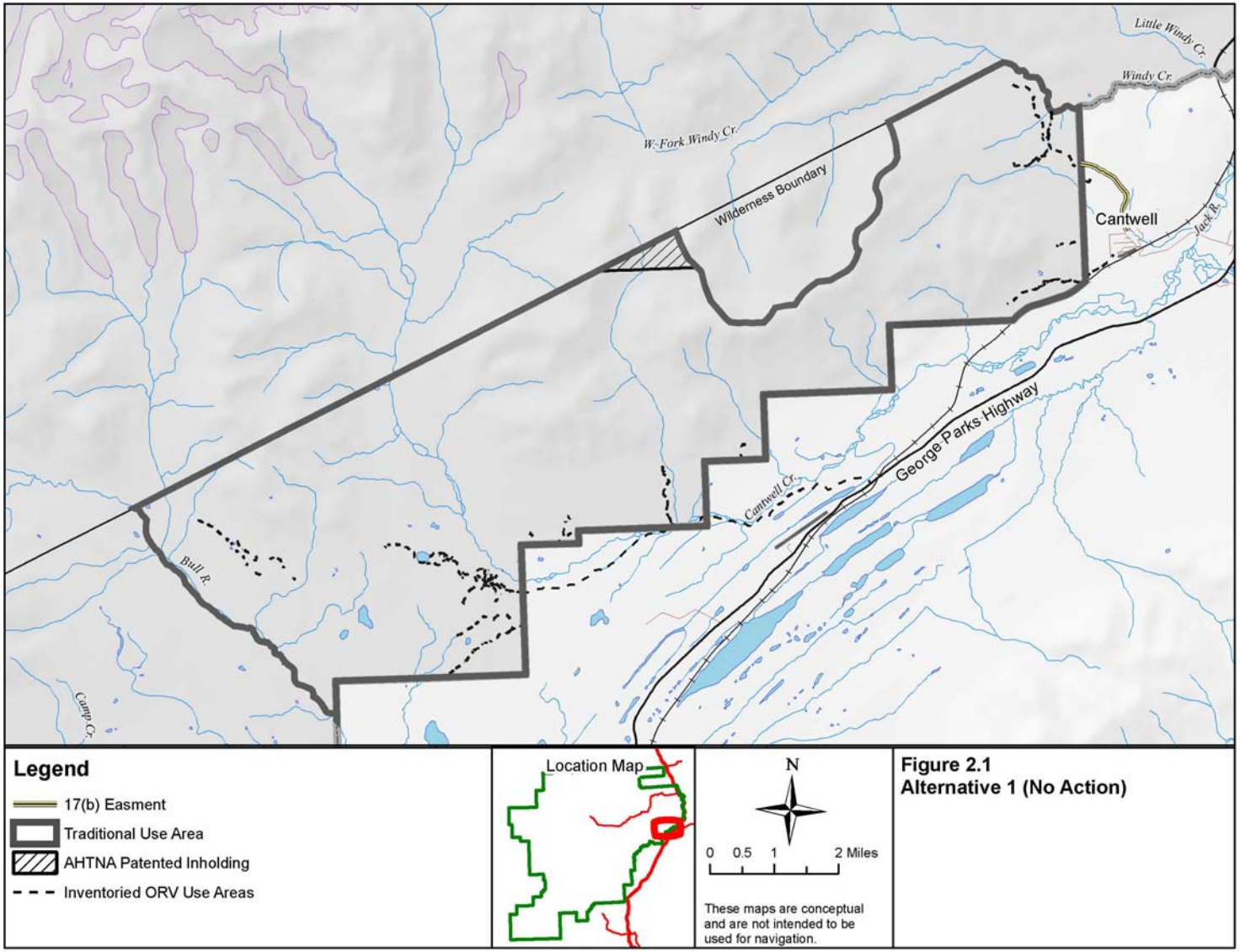

Figure 2.1
Alternative 1 (No Action)

evaluating the changes and impacts of the action alternatives. Additional information about existing conditions may be found in Chapter 3: The Affected Environment.

2.2.1 ORV Use Off-Trail

Off-trail ORV use would be allowed for all subsistence purposes by NPS qualified subsistence users throughout the Cantwell Traditional Use Area (TUA). There would be no limits on the types of ORVs that could be used.

2.2.2 ORV Use on Trails

ORV use on existing trails would continue to be allowed for all subsistence purposes by NPS qualified subsistence users throughout the TUA. There would be no limits on the types of ORVs that could be used.

2.2.3 ORV Use on the Bull River and Upper Cantwell Creek Floodplains

ORVs would be used for all subsistence purposes on the Bull River and Upper Cantwell Creek Floodplains. There would be no limits on the types of ORVs that could be used.

2.2.4 Closures

Although Departmental regulations (36 CFR 13.460(b)), give the park superintendent the authority to restrict or close a route or area if the superintendent determines that ORV use is or is likely to cause an adverse impact, for the purpose of analysis in this environmental assessment, no such management actions are predicted to occur under this No Action Alternative.

2.2.5 Harvest Limits

Under this alternative, the NPS would not seek to establish subsistence harvest limits for moose and caribou. Though this would not preclude establishing limits in the future if necessary to maintain or return moose and caribou populations to natural and healthy levels on park lands, for the purpose of analysis in this environmental assessment, no such management actions are predicted to occur under this No Action Alternative.

2.2.6 Degradation Levels

Having begun monitoring with the comprehensive survey of ORV use areas and impacts in 2005 (see Section 3.3.6), the NPS would continue to monitor the impacts of ORV use in the TUA (see Appendix 2). However, unlike under Alternatives 2, 3, and 4, the NPS would not establish specific degradation levels to aid in determining when management action is needed.

2.2.7 Zoning

The TUA would continue to be zoned “Management Area B” as prescribed in the 2006 Denali National Park and Preserve Backcountry Management Plan. The purpose of “Management Area B” is to provide opportunities for wilderness recreational activities suitable for day-users and overnight users that are remote and require self-reliance.

2.2.8 The 17 B Easement

The pre-existing 17B easement for public access across Ahtna Inc. property in the Windy Creek area near Cantwell would continue to be managed as it has in the past for the following uses: travel by foot, dogsleds, animals, snowmobiles, two- and three-wheel vehicles, and small all-terrain vehicles (ATVs) (less than 3,000 pounds gross vehicle weight) (See Section 1.6).

2.3 ALTERNATIVE 2

This alternative is based in part on recommendations made by the Denali Subsistence Resource Commission in its September 29, 1996, letter to the NPS (see Section 1.2). Under this alternative, the only off-trail ORV use permitted by NPS qualified subsistence users would be to retrieve harvested moose and caribou. In addition, use of ORVs by NPS qualified subsistence users engaged in subsistence activities would continue to be allowed on NPS-managed trails and routes (See Figures 2.2 and 2.3).

2.3.1 ORV Use Off-Trail

Within the Traditional Use Area (TUA), off-trail ORV use would be allowed only by permit for retrieval of harvested moose or caribou by NPS qualified subsistence users during the fall hunting season. ORVs could not be used in areas of the TUA that are closed for resource recovery or to protect sensitive habitat (see Section 2.3.4 below). In addition, hunters could continue to pack out harvested moose or caribou by foot, on dogsled, and with horses (including game carts).

The types of ORVs that may be used for retrieval of harvested moose or caribou would be:

> (1) 4-wheel drive ORVs that are no wider than 5.5 feet, have a maximum gross weight of 1,000 pounds, have a maximum engine size of 500 cc, and have no aggressive lugged/paddle tires;
>
> (2) Track-equipped ORVs that are no wider than 5.5 feet, have a maximum gross weight of 1,000 pounds, have no-skid steering, and have a ground pressure of less than 1.0 pound per square inch (PSI); or
>
> (3) Other ORVs that have been designed with the best available technology and can be shown to have equivalent or fewer impacts than the 4-wheel drive and track-equipped vehicles described above.

Trailers must meet the same width standards and weight or PSI standards as the vehicle to which they’re attached.

Subsistence users would be required to obtain a permit in advance from the NPS to use an ORV for off-trail retrieval of harvested moose or caribou. Retrieval permits would be issued by the NPS when a moose/caribou hunting permit is issued.

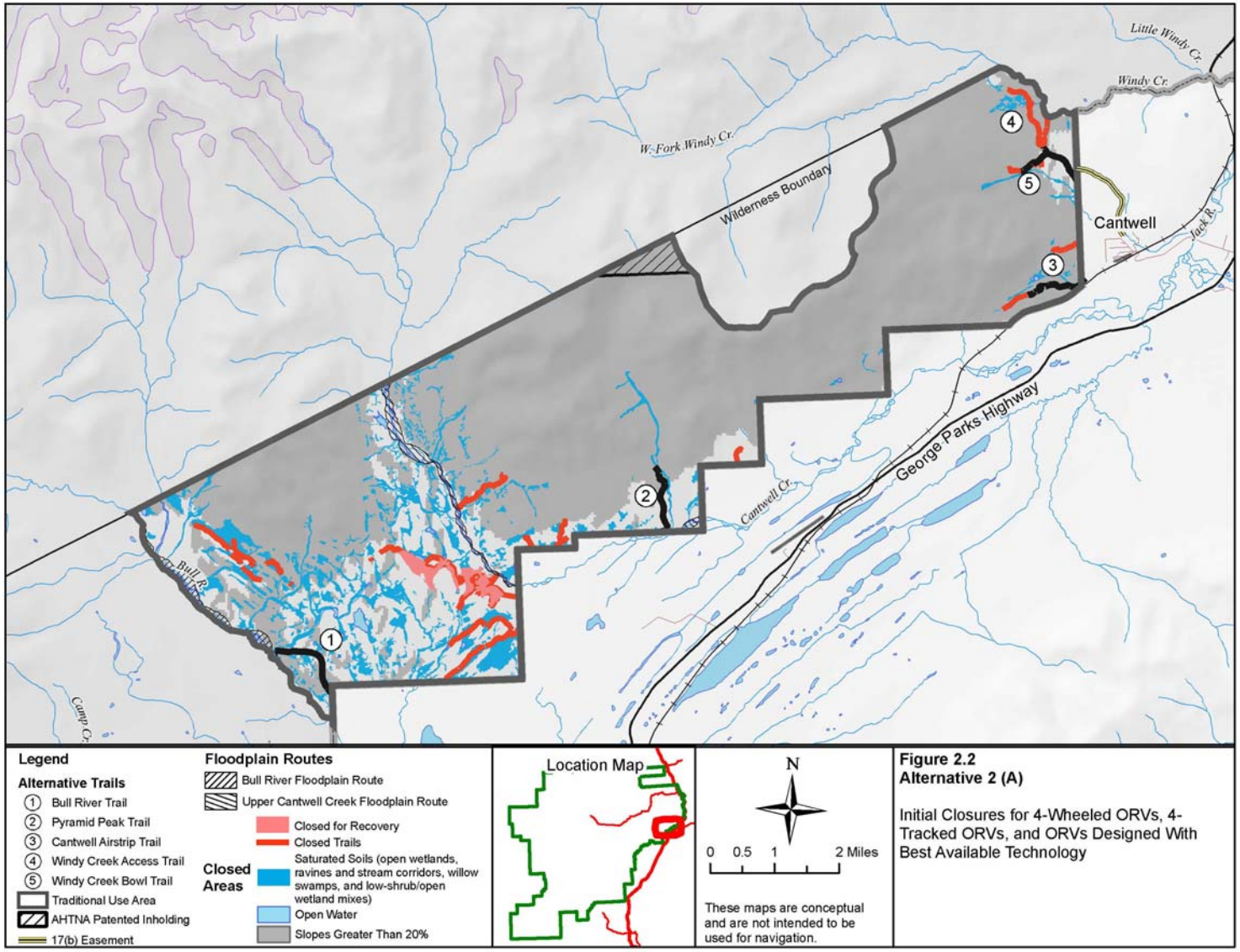

Figure 2.2
Alternative 2 (A)

Initial Closures for 4-Wheeled ORVs, 4-Tracked ORVs, and ORVs Designed With Best Available Technology

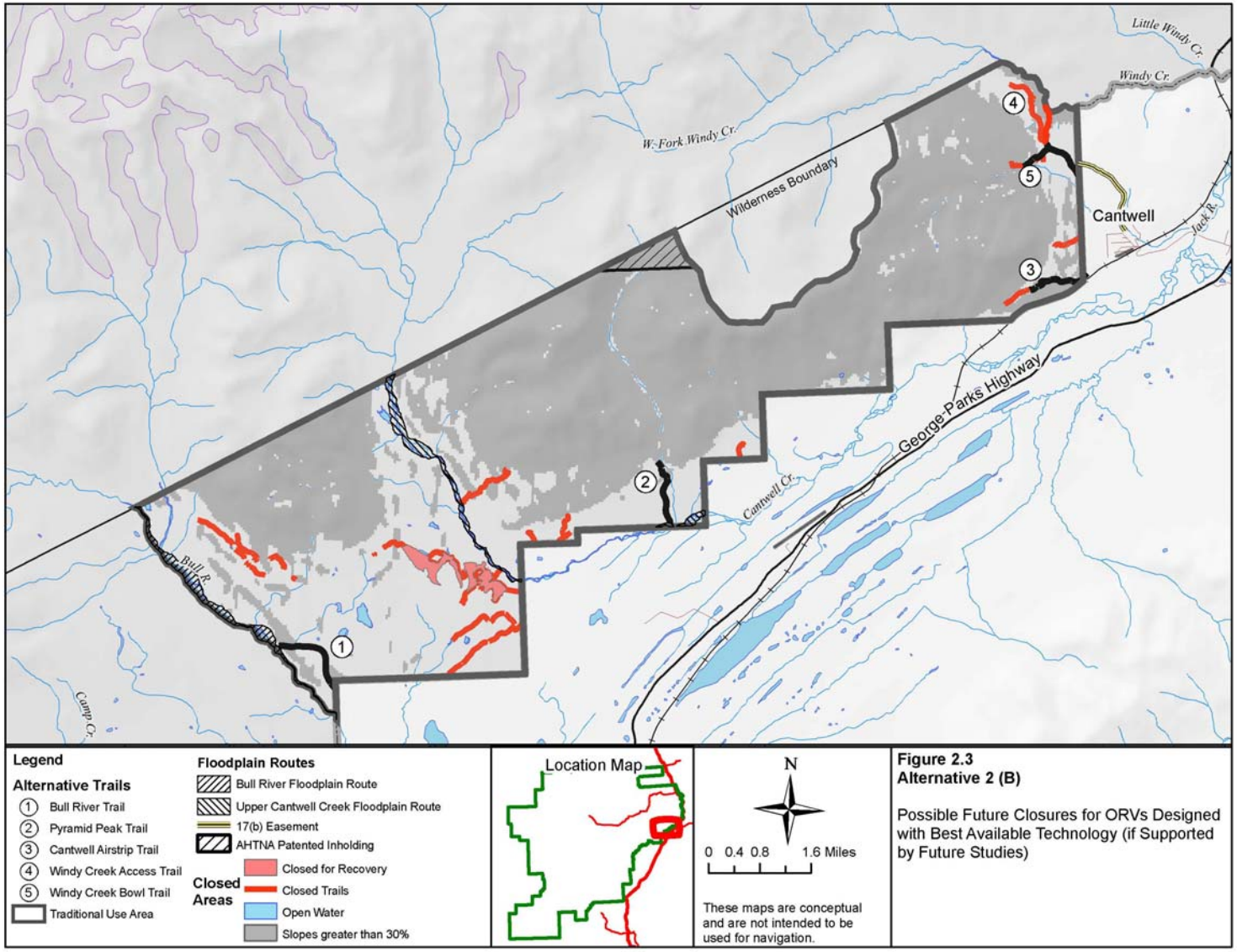

Figure 2.3
Alternative 2 (B)

Possible Future Closures for ORVs Designed with Best Available Technology (if Supported by Future Studies)

Travel guidelines or best practices would be provided with the permit and must be followed. For example, the NPS would require ORV turns to be gradual and occur at speeds less than 5 miles per hour; overland ORV travel speed would be limited to 10 miles per hour. Travel guidelines would also specify whether a single pass or multiple passes over the same route would be necessary to minimize impacts, depending on habitat type.

To aid the NPS in monitoring impacts of this off-trail use, the ORV user would be required to provide the NPS with a detailed map, a GPS-tracking log, or similar record identifying the travel path used for retrieval.

2.3.2 ORV Use on Trails

The following trails would be managed by the NPS for ORV use by NPS qualified subsistence users for all subsistence purposes:

- Windy Creek Access Trail;
- Windy Creek Bowl Trail;
- Cantwell Airstrip Trail;
- Pyramid Peak Trail; and
- Bull River Access Trail (new construction).

Use would be limited to any 4-wheel drive or tracked ORVs with a maximum width of 5.5 feet and a maximum gross vehicle weight limit of 1,000 pounds. To avoid impacting adjacent resources, there may be only one rolling vehicle at a time when ORVs pass each other along a trail.

Improvement of Existing NPS-Managed Trails

The NPS would implement management prescriptions to improve the existing Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail (see Appendix 5 for details about the management prescriptions). The management prescriptions are treatments that respond to identified degraded conditions along the trail alignments in an effort to halt active erosion and treat severely degraded tread conditions. The management prescriptions are based on a draft framework for managing ORVs in Alaskan NPS units (see Appendix 4 for more information on the framework). The NPS would implement the management prescriptions as soon as possible, with the goal of actual funding and implementation within 1-4 years. Trail maintenance and improvements generally would occur along the existing alignment and trails would be no wider than six feet.

Bull River Access Trail Construction Details

The new Bull River Access Trail would extend approximately 8,500 linear feet from the park boundary to the Bull River Floodplain. The NPS would implement a specific management prescription in constructing the new Bull River Access Trail (see Appendix 5 for details). As with the existing NPS-managed trails, trail maintenance and improvements generally would occur along the constructed alignment and the trail would be no wider than six feet.

Trail construction would occur over one season and would require the following support facilities and equipment:

- A 7-person base camp;
- Approximately 12 trips using a small four-place helicopter and approximately two half-days' use of a six-place helicopter for mobilization/demobilization activities;
- A mini excavator or equivalent (e.g., Bobcat 334);
- All-wheel drive ORVs (400-500cc in size);
- ORV box trailers;
- ORV belly dump trailers; and
- A 2,500 watt generator.

2.3.3 ORV Use on the Bull River and Upper Cantwell Creek Floodplains

Both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for ORV use by NPS qualified subsistence users for all subsistence purposes. However, until the Bull River Access Trail was constructed, the floodplain of the Bull River would only be open to subsistence ORV use for retrieval of harvested moose or caribou.

The NPS would adhere to the following management guidelines for ORV use on the Bull River and Upper Cantwell Creek Floodplains:

- ORV travel alignments along vegetated sections of the floodplain would initially be marked. If monitoring shows unacceptable impacts, trail segments would be constructed.
- In general, floodplains would not be marked where the path from point A to point B is obvious and where there is no vegetation or sensitive resources.
- Any 4-wheel drive or tracked ORVs with a maximum width of 5.5 feet and a maximum gross vehicle weight limit of 1,000 pounds would be allowed on the floodplains.
- Vegetated areas adjacent to the floodplains would be closed to ORV use except as necessary for retrieval of harvested moose or caribou (see Section 2.3.1 above).

If construction of trail segments was warranted, the NPS would develop trail prescriptions, which could entail one or more of the following: brush clearing; surface blading; gravel capping, or other forms of hardening; cutting ramps on or off elevated bars; creating cross drainage; using techniques to prevent streams from following user-created channels; and flagging/marking.

Because of the dynamic floodplain landscape, the NPS would expect to mark floodplain routes annually. For the same reason, if trail segments were constructed, annual maintenance would be required to address such issues as: ramp washouts from high water events and channel migration; water flow along new alignments during high water events; erosion issues; loss of flagging/markers; and vegetation control.

<u>The Bull River Floodplain Alignment</u>

Figure 2.4 shows an estimated alignment for a Bull River Floodplain Trail/Route (note, this alignment is for analysis purposes only). The total length of the alignment would be about 4.5 miles, with more than 80% on unvegetated gravel bars and less than 10% on vegetated gravel bars or vegetated abandoned channels.

As noted above, if unacceptable impacts occur from ORV use along the vegetated portions of the alignment, constructed trail segments would be required. At most, such a trail would be required along about 10 % of the Bull River Floodplain alignment – or about half a linear mile. Although the NPS could find that actual ground conditions require less work, for the purpose of analysis in this EA it's assumed that the trail prescription would require blading and gravel fill or capping to create the trail. Gravel could be obtained from the active floodplain and transported to the trail via motorized equipment such as small bobcats with loader attachments. Another possible source of gravel would be beneath the trail alignment itself.

The estimated alignment indicates that there would be approximately 30 crossings of the main river channel and secondary channels. Crossings of tributary channels would be minimal.

Photo 2.1 (left) – Lightly vegetated gravel bar. Photo 2.2 (right) – Floodplain with isolated non-vegetated gravel bars separated by willow shrublands, secondary channels, and wet swales. Both photos taken on Upper Cantwell Creek floodplain.

Upper Cantwell Creek Floodplain Alignment

Figure 2.5 shows an estimated alignment for an Upper Cantwell Creek Floodplain Trail/Route (as for the Bull River Floodplain, this alignment is for analysis purposes only). The total length of the route alignment would be about 4.5 miles, with about 50% on unvegetated gravel bars and about 45% on vegetated gravel bars or vegetated abandoned channels.

As noted above, if unacceptable impacts occur from ORV use along the vegetated portions of the alignment, constructed trails would be required. At most, such a trail would be required along about 45 % of the Upper Cantwell Creek Floodplain alignment – or about two linear miles. Although the NPS could find that actual ground conditions require less work, for the purpose of analysis in this EA it's assumed that the trail prescription would require blading and gravel fill or capping to create the trail. As with the Bull River Floodplain, gravel could be obtained from the active floodplain and transported to the trail via motorized equipment such as small bobcats with loader attachments. Another possible source of gravel would be beneath the trail alignment itself.

There would be approximately 35 crossings of the main river channel and secondary channels. Crossings of tributary channels would be minimal.

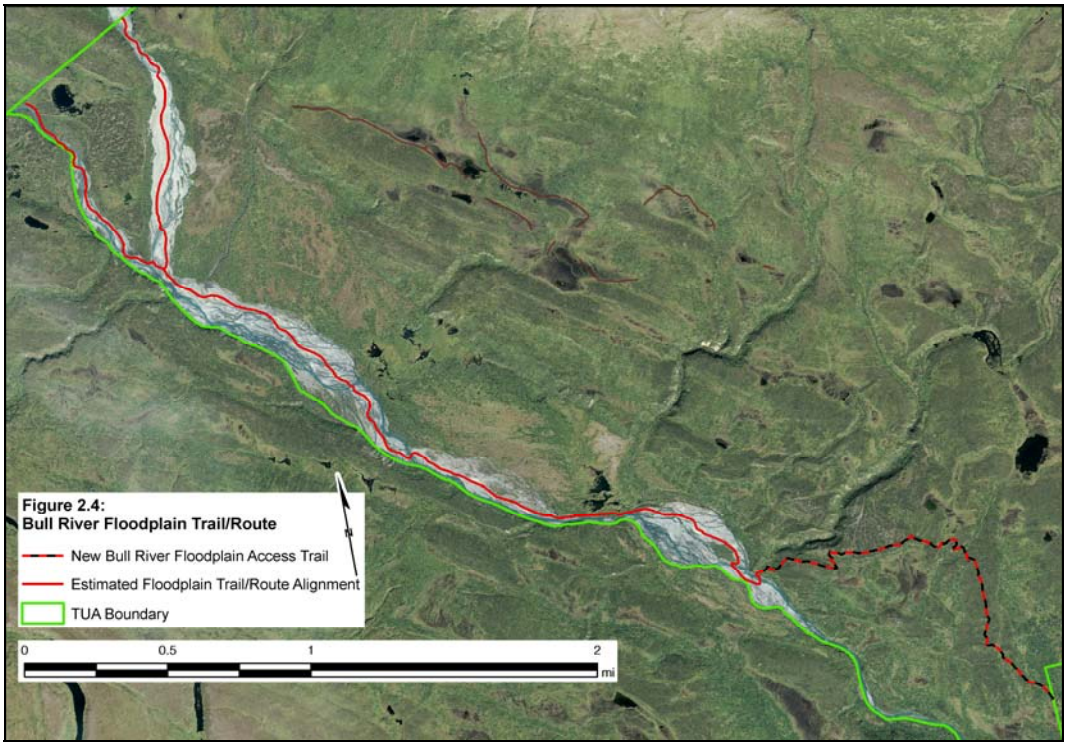
Figure 2.4:
Bull River Floodplain Trail/Route
New Bull River Floodplain Access Trail
Estimated Floodplain Trail/Route Alignment
TUA Boundary
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2
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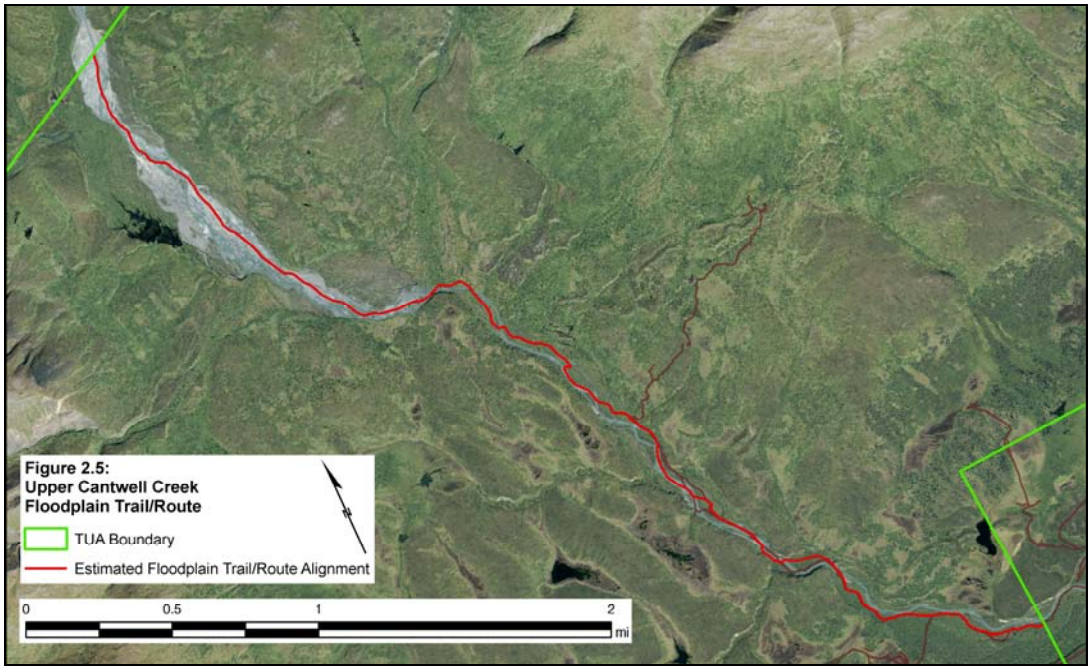
Figure 2.5:
Upper Cantwell Creek
Floodplain Trail/Route
TUA Boundary
Estimated Floodplain Trail/Route Alignment
0
0.5
1
2
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2.3.4 Closures

Under the authority of 36 CFR 13.460(b), the NPS would immediately close trails and areas within the TUA that currently exhibit unacceptable adverse impacts on park resources ("recovery closures"). These recovery closures would be closed to all ORV use. ORV use that is not consistent with NPS requirements and travel guidelines, and which causes new unacceptable adverse impacts, would be a citable offense and likely would result in closing any newly damaged area until it recovers. Although closures initially would be effected under 36 CFR 13.460(b), the NPS would initiate the necessary steps to promulgate the closures as a regulation.

ORV use would not be allowed during spring breakup conditions until the NPS determines that travel would not result in damage.

In addition, to prevent new adverse impacts from being created, the following areas would be permanently closed to ORVs traveling off NPS-managed trails or routes:

1. Open water (i.e., areas with equal to or greater than one inch of permanent standing water).
2. Slopes greater than 20%
3. Areas with saturated soils such the following vegetation covers: open wetlands, ravines and stream corridors, willow swamps, and low-shrub/open wetland mixes. (Note that other vegetation covers like willow or alder shrublands and spruce-willow/alder woodlands also have some saturated soils but these aren't included in this closure.)

Initially, under this alternative, 4-wheel drive ORVs, track-equipped ORVs, and ORVs designed with best available technology would be managed in the same manner and none would be allowed to travel in the closed areas just described. However, if future long-term studies find that ORVs designed with best available technology have minimal impacts on sensitive habitat or steeper slopes and that such impacts would be below the warning or action degradation levels proposed under this alternative (see Table 2.2), then they may be allowed across a wider area.

In the future, if ORV use must be limited, the NPS would give priority to use of ORVs for retrieval of harvested moose or caribou.

Signs indicating closure of the TUA to off-trail use would be posted and barriers (most likely split rail fencing) would be placed at the start of all trails that would now be closed under this alternative. In addition, the NPS would work to actively rehabilitate two closed trail sections to prevent ongoing degradation. Water control features and vegetative plugs would be used to rehabilitate the closed trail section that extends above the campsite at the end of the Windy Creek Bowl Trail and the closed section that extends from the Windy Creek Access Trail down to the Windy Creek ravine. Once rehabilitated, these trails would remain closed to ORV use.

2.3.5 Harvest Limits

The NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to establish subsistence harvest limits for moose and caribou as necessary to maintain natural and healthy moose and caribou populations on park lands.

The National Park Service would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit.

2.3.6 Degradation Levels

Monitoring provides information about the impact of ORV use on park resources (see Appendix 2 for monitoring strategies under this alternative). When this information shows that resource degradation is moving toward unacceptable levels or is already at such levels, management action would be taken.

Under this alternative, two levels of degradation would be established: warning levels and action levels.

- Warning Levels indicate that conditions are deteriorating and managers would be advised to take action but wouldn't be required to do so.
- Action Levels indicate that impacts have already reached unacceptable levels and managers would take immediate management action to remedy the situation.

Warning and action levels differ depending on whether they're associated with trails, routes and off-trail areas, or with all three. Tables 2.1 and 2.2 present preliminary sets of potential warning and action degradation levels for several indicator categories. While these would define levels for individual impacts, the following action levels would be established for collective impacts:

1. For impacts identified along a trail, managers would take immediate action if the sum of the trail segment lengths (in linear meters) at warning or action levels exceeds 15% of the total trail length.
2. For impacts identified in off-trail areas and routes, beginning in 2009 or 2010 (when impacts would become apparent), managers would take immediate action if visible/detectable degraded conditions, even those that are below the warning levels, are accumulating within the Traditional Use Area faster than impacts are recovering. In other words, there should be no net gain in degradation over what was identified in the 2005 inventory.

As noted, all of these degradation levels are preliminary. To confirm these levels, they must be field-tested, which may result in modifications.

Management Tools to Respond to Degradation Levels

Table 2.3 lists the tools that may be used to manage access when necessary in response to conditions reaching warning or action degradation levels. These tools are arranged in rough order from the least restrictive to the most restrictive. The park superintendent would be free to pick whichever tool is required as long as the "least restrictive" criterion is heeded. There would be no implication that the tools must be tried in the listed order and a failure elicited before trying the next one.

2.3.7 Zoning

During the summer and fall seasons, the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, Bull River Access Trail, and the NPS-managed trails and routes within the Bull River and Upper Cantwell Creek Floodplains all would be rezoned

Table 2.1 Degradation Levels for the TUA (Except the Upper Cantwell Creek and Bull River Floodplains Which Are Covered By A Separate Set of Degradation Levels).

CATEGORY	WARNING DEGRADATION LEVELS	ACTION DEGRADATION LEVELS
Trail Width		
Trails	Trail width exceeds design width specifications or original construction by greater than 20% of width necessary for passage of class of vehicle using it. .	Trail width exceeds design width specifications or original construction by greater than 30% of width necessary for passage of class of vehicle using it
Routes and Off-Trail Areas	N/A	N/A
Trails, Routes, and Off-Trail Areas	N/A	N/A
Multiple Passes		
Trails	N/A	Evidence of multiple parallel passes
Routes and Off-Trail Areas	N/A	Evidence of multiple parallel passes that persist for years.
Trails, Routes, and Off-Trail Areas	N/A	N/A
Soil Organic Mat Disruption		
Trails	Disruption of the soil organic mat on off-trail areas; e.g., from vehicle passing or other operation off of the main, modified trail surface onto saturated soils.	Disruption, removal, or perforation of organic mat off-trail that persists for more than one season on any segment of 3 meters or more.
Routes and Off-Trail Areas	Perforation or removal of organic mat totaling 15% of any 10 meter segment.	Perforation or removal of organic mat persists for more than one season totaling 50% of any 5 meter segment.
Trails, Routes, and Off-Trail Areas	N/A	N/A
Slope Class		
Trails	N/A	N/A
Routes and Off-Trail Areas	N/A	Pass alignment grade is at or greater than 20% for four-wheeled ORVs or other ORVs not designed with BAT and at or greater than 30% for ORVs designed with BAT
Trails, Routes, and Off-Trail Areas	N/A	N/A
Soil Compaction		
Trails	Wheel ruts, track depressions, or any other sort of trail surface compaction have depressed the trail surface between 2 and 6 inches below the surrounding soil surfaces and these impacts persist year to year along 50% of any 10 meter or longer section of trail.	Wheel ruts, track depressions, or any other sort of trail surface compaction have depressed the trail surface greater than 6 inches below the surrounding soil surfaces and these impacts persist year to year along 50% of any 10 meter or longer section of trail *and* these impacts have the potential to get worse because there is no underlying mineral or well-drained soil.
Routes and Off-Trail Areas	Visible ruts persist from year to year that are between 2 and 3 inches along 50% of any 10 meter or longer pass.	Visible ruts persist from year to year that are greater than 3 inches deep along 50% of any 10 meter or longer pass.
Trails, Routes, and Off-Trail Areas	N/A	N/A

CATEGORY	WARNING DEGRADATION LEVELS	ACTION DEGRADATION LEVELS
Soil Erosion		
Trails	N/A	N/A
Routes and Off-Trail Areas	Exposed soils along 15% of any 10 meter or longer pass.	N/A
Trails, Routes, and Off-Trail Areas	N/A	Any evidence of active transport erosion along 25% of any 10 meter or longer section of trail or pass.
Mud-Muck		
Trails	Trail surface has a thick surface of mud greater than 2 inches deep.	Trail surface has a thick surface of mud greater than 8 inches deep. The alignment is seasonally impassable due to severely degraded conditions. The alignment is impassable at all times due to severely degraded conditions.
Routes and Off-Trail Areas	N/A	N/A
Trails, Routes, and Off-Trail Areas	N/A	Any large, single, deep water and mud filled hole or depression that alters travel. Two or more adjacent or nearly continuous muck holes, still passable by ORVs.
Persistent Drainage		
Trails	N/A	N/A
Routes and Off-Trail Areas	N/A	N/A
Trails, Routes, and Off-Trail Areas	Standing water along alignment over organic or fine textured soils during normal weather conditions (ponding).	Modifications in surface hydrology occurring, such stream capture, or such as water running along the surface of the trail/pass in sufficient quantity to cause erosion (see Soil Erosion above).
Stoniness		
Trails	Between 10% and 25% of the trail surface has large stones that hinder travel.	More than 25% of the trail surface has large stones that hinder travel.
Routes and Off-Trail Areas	N/A	N/A
Trails, Routes, and Off-Trail Areas	N/A	N/A
Stream Sedimentation		
Trails	N/A	N/A
Routes and Off-Trail Areas	N/A	N/A
Trails, Routes, and Off-Trail Areas	Evidence of persistent sedimentation immediately below an ORV stream crossing (soft-substrate streams only).	Evidence of persistent sedimentation 20 meters or more below an ORV stream crossing (soft-substrate streams only).

Table 2.2 Degradation levels for Upper Cantwell Creek and Bull River Floodplains.

CATEGORY	WARNING DEGRADATION LEVELS	ACTION DEGRADATION LEVELS
Trail Width	Any developed trail segment crossing and stripping vegetation what exceeds 83 inches (1.5 times the necessary width to pass permitted sized vehicles).	Any developed trail segment crossing and stripping vegetation that exceeds 110 inches (2 times the necessary width the pass permitted vehicles).
Multiple Passes	Evidence of more than 2 multiple passes through a vegetated area that has stripped live foliage but not stripped vegetation to the ground surface on more than one trail alignment.	Evidence of more than 2 multiple passes through a vegetated area that has stripped vegetation to the ground surface.
Soil Organic Mat Disruption	A secondary alignment through a vegetated area that has the potential of stripping vegetation to the ground surface.	More than one alignment through a vegetated area that has stripped vegetation to the ground surface.
Slope Class	Any trail segment within 25 feet of a receiving water body traversing a slope >10% or a cut bank with a >10% grade.	Any trail segment traversing a slope or steep cut bank that is eroding and causing significant sediment discharge into receiving waters.
Soil Compaction	None	None
Soil Erosion	Any trail segment that is eroding and has the potential of causing significant sediment discharge into receiving waters.	Any trail segment that is eroding and causing significant sediment discharge into receiving waters.
Mud-Muck	Any trail segment that has developed a muddy surface >2 inches thick that has the potential of a significant discharge into receiving waters.	Any trail segment that has developed a muddy surface > 2 inches thick that is actively discharging significant sediment into receiving waters.
Persistent Drainage	None	Water activity running along a created trail alignment through a vegetated section (stream capture)None, unless it leads to another listed action degradation level.
Stoniness	None	W
Stream Sedimentation	Evidence of persistent sedimentation immediately below an ORV stream crossing (soft-substrate streams only).	Evidence of persistent sedimentation 20 meters or more below an ORV stream crossing (soft-substrate streams only).

from "Management Area B" to "Corridor." The purpose of the Corridor management area is to provide for high-use travel via ground or water accessing remote parts of the park and preserve.

2.3.8 The 17 B Easement

The pre-existing 17B easement for public access across Ahtna Inc. property in the Windy Creek area near Cantwell would continue to be managed as it has in the past, including restricting the maximum gross vehicle weight on this trail to 3,000 pounds. In addition, the NPS would take action to improve the easement by implementing a specific set of management prescriptions (see Appendix 5 for details about the management prescriptions). The NPS would implement the management prescriptions as soon as possible, with the goal of actual funding and implementation within 1-4 years.

Table 2.3 Management tools that may be used to manage access in response to conditions reaching warning or action degradation levels

1) Education	The National Park Service would provide printed material, public presentations, targeted presentations to user groups, and Internet-based programs, with the goal of actively involving visitors in helping the park achieve the standards for all management areas.
2) Increased enforcement of existing regulations	The National Park Service would prioritize enforcement of existing regulations to assist in achieving standards for management areas.
3) Voluntary restrictions	The National Park Service would ask ORV users to restrict their use voluntarily. Examples of such measures could include: voluntary registration; use of low-impact equipment; avoidance of certain areas of the TUA; or avoidance of areas during particular seasons or weather conditions. Voluntary registration would not require a permit and could be accomplished by trailhead register, phone or radio call-in, or the Internet.
4) Required registration	The National Park Service would require ORV users to register. ORV users would be issued a permit that provides information about park rules and conditions for use necessary to protect park resources. Permit conditions could include minimum impact travel requirements and resource protection requirements; however, a registration process would not limit the number of ORV users or the type or amount of access.
5) Technology requirements or other requirements governing means of access	To achieve management area standards, the National Park Service would place requirements on the types of ORVs used.
6) Regulate numbers of ORVs or the number of ORV passes	The National Park Service would establish quotas for ORV numbers or passes in areas of the TUA when the volume of use is high enough that other mechanisms are unlikely to achieve standards. ORV users would be required to register and carry a permit, and the number of available permits would be limited.
7) Temporal restrictions	The National Park Service would restrict access to particular times of year based upon surface conditions, or the duration of access could be limited.
8) Temporary and permanent closures	Using the appropriate authorities, the National Park Service would temporarily or permanently close areas of the park and preserve to all types of visitor use or to specific types of access until conditions stabilize or recover.
9) Physical mitigation measures	Develop and implement mitigation measures to reduce environment and use impacts. For instance, rolling grade dips could be installed to control erosion, short sections could be hardened, climbing turns could be integrated to lower over-steepened grades, or short sections of trails could be re-routed around sensitive sites.

2.4 ALTERNATIVE 3 (NPS Preferred Alternative)

The Cantwell Traditional Use Area (TUA) would remain open to use of ORVs by NPS qualified subsistence users for all subsistence purposes only on NPS-managed trails and routes. In addition, the NPS would work with the Federal Subsistence Board and others to implement a winter subsistence moose hunt (See Figure 2.6).

2.4.1 ORV Use Off-Trail

There would be no off-trail use of ORVs for subsistence or any other purposes within the TUA. Instead, the NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. Winter in this context means the time of year when the ground is frozen and there's adequate snow cover for snowmachine use. The winter hunt likely would be open until harvest limits are reached. In addition, hunters could continue to pack out harvested moose or caribou by foot, on dogsled, and with horses, including game carts.

2.4.2 ORV Use On Trails

As described for Alternative 2, the following trails would be managed by the NPS for ORV use by NPS qualified subsistence users for all subsistence purposes:

- Windy Creek Access Trail;
- Windy Creek Bowl Trail;
- Cantwell Airstrip Trail;
- Pyramid Peak Trail; and
- Bull River Access Trail (new construction).

These NPS-managed trails would be treated the same as described under Alternative 2 (see Section 2.3.2).

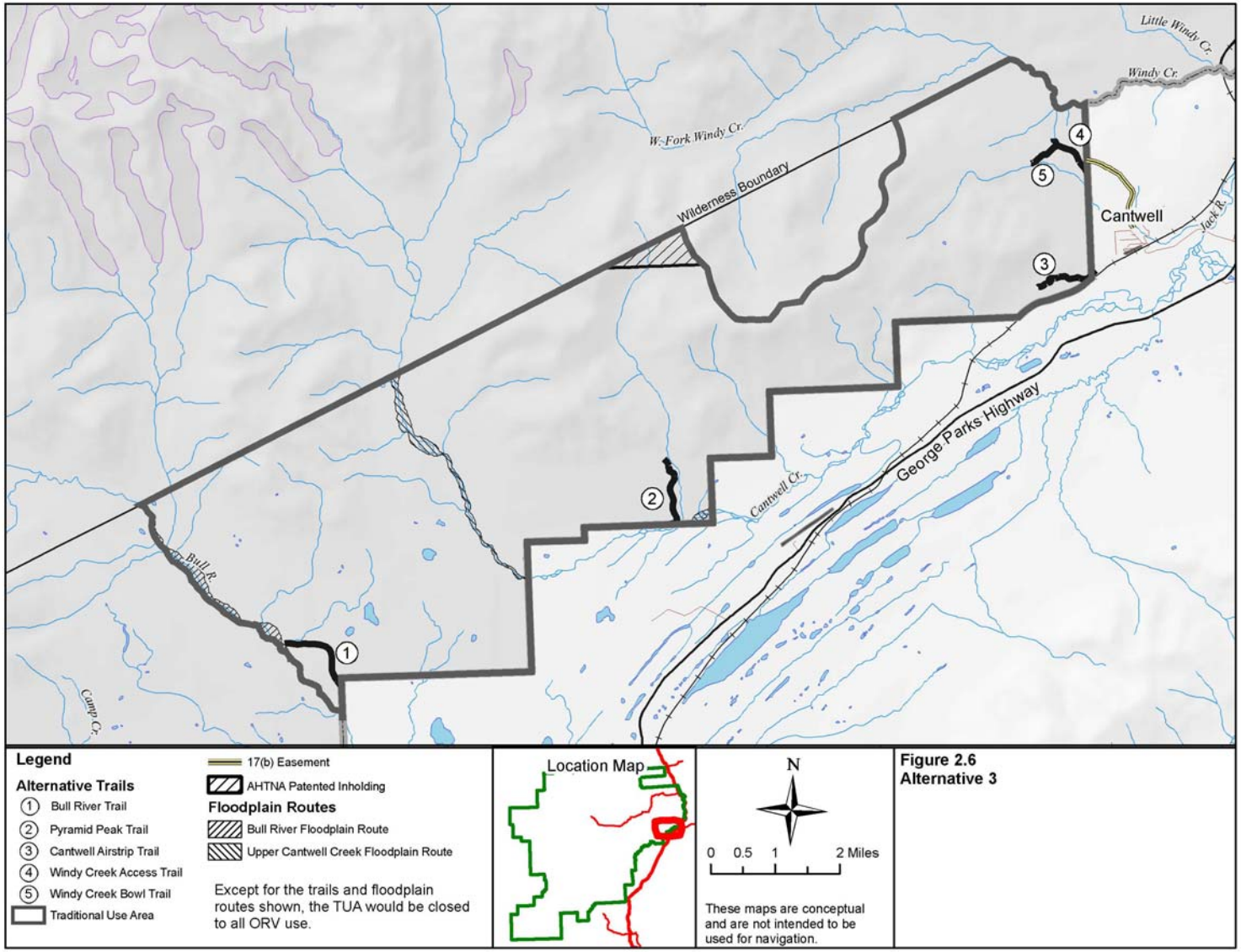
2.4.3 ORV Use On the Bull River and Upper Cantwell Creek Floodplains

As described under Alternative 2, both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for ORV use by NPS qualified subsistence users for all subsistence purposes (see Section 2.3.3). However, unlike under Alternative 2, vegetated areas adjacent to the floodplains would be closed to all ORV use (see Section 2.4.1).

2.4.4 Closures

Areas off of NPS-managed trails and routes would be closed by regulation to ORV use, including the "recovery closures" as described under Alternative 2.

ORV use would not be allowed during spring breakup conditions until the NPS determines that travel would not result in damage.


Little Windy Cr.
Windy Cr.
W. Fork Windy Cr.
Wilderness Boundary
Cantwell
Jack R.
George Parks Highway
Cantwell Cr.
Bull R.
Camp Cr.
1
2
3
4
5
Legend
Alternative Trails
1 Bull River Trail
2 Pyramid Peak Trail
3 Cantwell Airstrip Trail
4 Windy Creek Access Trail
5 Windy Creek Bowl Trail
Traditional Use Area
17(b) Easement
AHTNA Patented Inholding
Floodplain Routes
Bull River Floodplain Route
Upper Cantwell Creek Floodplain Route
Except for the trails and floodplain routes shown, the TUA would be closed to all ORV use.
Location Map
N
0 0.5 1 2 Miles
These maps are conceptual and are not intended to be used for navigation.
Figure 2.6
Alternative 3

In the future, if subsistence ORV use must be limited even on the NPS-managed trails and routes, the NPS would give priority to using ORVs along these trails and routes in order to get closer to harvested moose or caribou and facilitate their retrieval.

Signs indicating closure of the TUA to off-trail use would be posted and barriers (most likely split rail fencing) would be placed at the start of all trails that would now be closed under this alternative. In addition, the NPS would work to actively rehabilitate two closed trail sections to prevent ongoing degradation: water control features and vegetative plugs would be used to rehabilitate the closed trail section that extends above the campsite at the end of the Windy Creek Bowl Trail and the closed section that extends from the Windy Creek Access Trail down to the Windy Creek ravine. Once rehabilitated, these trails would remain closed to ORV use.

2.4.5 Harvest Limits

Potential harvest limits for moose, caribou, and wolves would be the same as described under Alternative 2.

2.4.6 Degradation Levels

Degradation levels would be the same as described under Alternative 2.

2.4.7 Zoning

Zoning changes would be the same as described under Alternative 2,

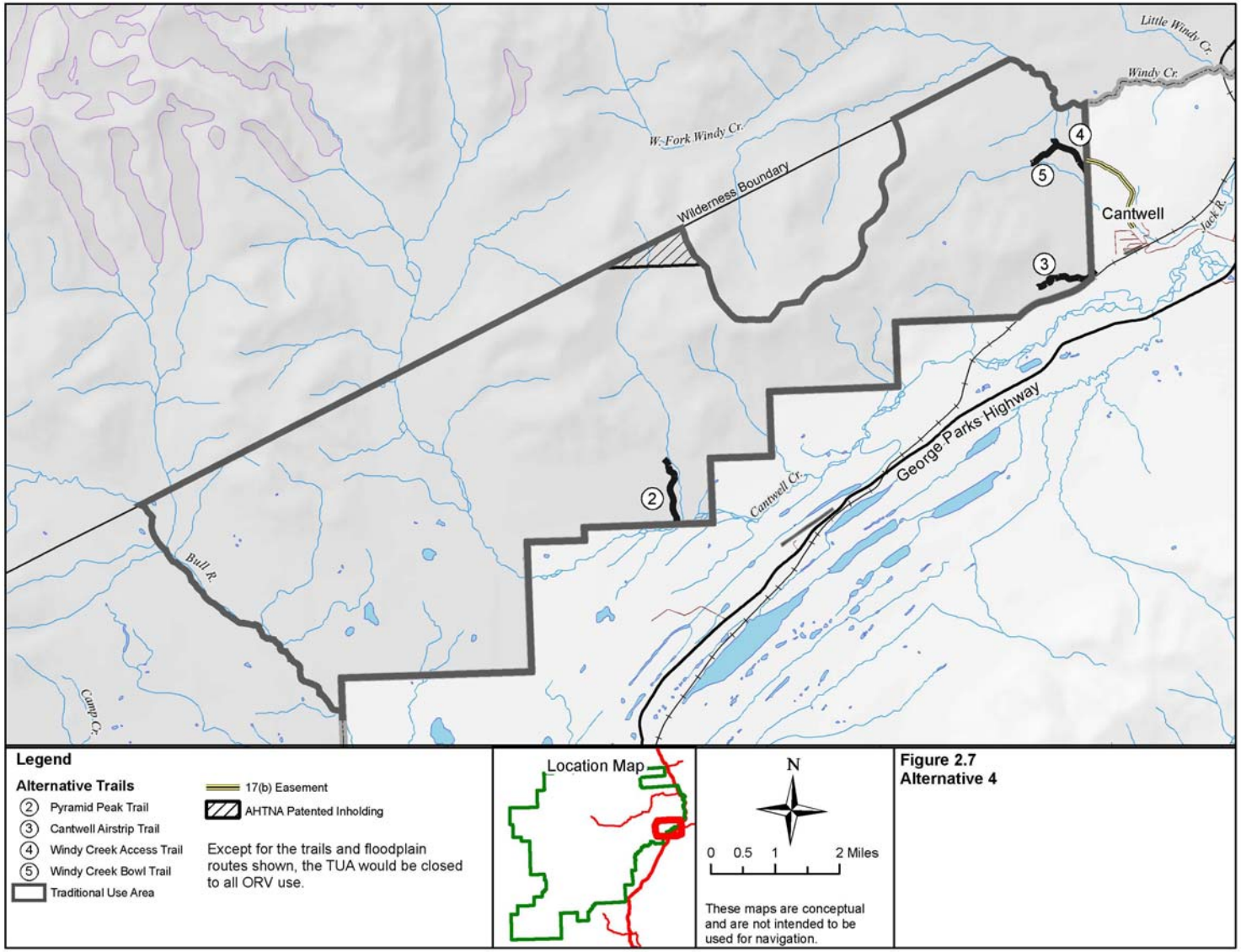
2.4.8 The 17 B Easement

The 17B Easement would be managed as described under Alternative 2.

2.5 ALTERNATIVE 4

Alternative 4 would be similar to Alternative 3, except for the following differences:

1. The NPS would not construct the new Bull River Access Trail.
2. ORVs would not be authorized on either the Bull River or Upper Cantwell Creek Floodplains.
3. The NPS would authorize ORV use for subsistence purposes only on the
    a. Windy Creek Access Trail,
    b. Windy Creek Bowl Trail,
    c. Cantwell Airstrip Trail, and the
    d. Pyramid Peak Trail.
4. ORV use for subsistence purposes would be authorized on these four trails *only* from one week before the beginning of the fall moose and caribou hunting seasons until the end of these hunting seasons.
5. During the summer and fall seasons, these four trails would be rezoned from “Management Area B” to “Corridor.”


Little Windy Cr.
Windy Cr.
W. Fork Windy Cr.
Wilderness Boundary
4
5
Cantwell
Jack R.
3
George Parks Highway
2
Cantwell Cr.
Bull R.
Camp Cr.
Legend
Alternative Trails
2 Pyramid Peak Trail
3 Cantwell Airstrip Trail
4 Windy Creek Access Trail
5 Windy Creek Bowl Trail
Traditional Use Area
17(b) Easement
AHTNA Patented Inholding
Except for the trails and floodplain routes shown, the TUA would be closed to all ORV use.
Location Map
N
0 0.5 1 2 Miles
These maps are conceptual and are not intended to be used for navigation.
Figure 2.7
Alternative 4

2.6 MITIGATING MEASURES

Fish Habitat: On the Upper Cantwell Creek and the Bull River Floodplains, the NPS would conduct a fish inventory of the river channels and tributaries to determine the presence of fish and related spawning and rearing habitat. If necessary, water crossings would be marked to ensure they are in appropriate places to minimize sedimentation and avoid spawning areas.

Cultural Resources: If cultural resources were discovered during ORV trail maintenance, improvement, or construction activities, the site would be protected and the activities would stop until the park archeologist can be notified and has the opportunity to evaluate the site.

Migratory Birds: Under the Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703), it is illegal to "take" migratory birds, their eggs, feathers or nests. “Take” includes by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing or transporting any migratory bird, nest, egg, or part thereof. The MBTA does not distinguish between intentional and unintentional take. Vegetation clearing, site preparation, or other construction activities that may result in the destruction of active bird nests or nestlings would violate MBTA. In order to avoid violations of the MBTA, bird habitat (vegetation) would not be removed during the nesting season, April 1 through July 15. After completing all the nesting vegetation removal required for the project, there would be no seasonal restriction for construction activities, even during the following nesting seasons. If any active nest were encountered at any time, it would be protected from destruction. “Active” is indicated by intact eggs, live chicks, or presence of an adult on the nest. Eggs, chicks, or adults of wild birds would not be destroyed (Zelenak 2005).

Rare Plants: *Botrychium alaskaense* occurs in river flats in the vicinity of the Traditional Use Area of Denali National Park, and thus surveys for this taxon along Cantwell Creek and Bull River should be performed before choosing a designated route through this area.

2.7 ENVIRONMENTALLY PREFERRED ALTERNATIVE

As stated in Section 2.7 (D) of the NPS DO-12 Handbook, “The environmentally preferred alternative is the alternative that will best promote the national environmental policy expressed in NEPA (Section 101(b)).” The environmentally preferred alternative is the alternative that not only results in the least damage to the biological and physical environment, but that also best protects, preserves, and enhances historic, cultural, and natural resources.
Alternative 4 is the environmentally preferred alternative because it would have the fewest impacts to the biological and physical environment; however, it would have the greatest impact on cultural and traditional use patterns.

2.8 ALTERNATIVES AND ACTIONS CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

Several alternatives were considered during the public and agency scoping process but were eliminated from further evaluation in this EA. This section describes the alternatives and actions that were considered and provides justification for their elimination.

2.8.1 No Limits on ORV Type for Moose/Caribou Retrieval. This proposal would be the same as Alternative 2, except the NPS would not place restrictions on the types of ORVs used to retrieve harvested moose or caribou. This alternative was eliminated because it would not meet

the specific project purpose (see Section 1.1), specifically minimizing adverse impacts to the resources and values for which the park was established.

2.8.2 Manage All Existing Trails for Continued ORV Use. This action would require maintaining or improving all of the existing ORV trails in the TUA. This action was dismissed because many of these trails are duplicative or are too heavily impacted and need to be closed for recovery.

2.8.3 Reconsider Resident Zone Status of Cantwell. This action would re-examine the resident zone status of Cantwell. Under this action, the resident zone could be replaced by a system of individual subsistence use permits for those residents who have customarily and traditionally engaged in subsistence uses in the park without using aircraft as a means of access. This proposal would not significantly change the present need to manage, or change the impacts from, use of ORVs by qualified subsistence users in the TUA. It also would require a lengthy regulatory process with an uncertain outcome.

2.8.4 Include Dunkle Hills in the Cantwell Traditional Use Area. The decision to exclude the Dunkle Hills from the Cantwell TUA was made as part of the *2005 Cantwell Subsistence Traditionally Employed ORV Final Determination.* No additional facts have been revealed which would change that decision. Additionally, reconsidering that decision is outside the scope of this EA.

2.8.5 Allow ORV Use Only on NPS-managed Trails When There's Adequate Ground Frost To Support the Vehicles Without Causing Impacts to Soils or Water Quality. Given the standard snow regime on the south side of the Alaska Range (including the TUA), there is no time when there is frost on the ground but no snow on the ground. For this reason, this action was not considered fully in the EA.

2.8.6 ORV Access Allowed, But Limited to the Same Number of ORV Users as in 1980. This option was not fully evaluated, because there is too much uncertainty about the correlation between 1980 ORV use levels within the TUA and potential resource damage. Therefore, to limit the use levels to this number would be an arbitrary decision.

2.8.7 Close Entire Traditional Use Area to ORVs. This alternative was considered and analyzed in the NPS internal review draft EA; however, it was eliminated from further study because it does not fulfill the specific project purpose (see Section 1.1), specifically providing reasonable access for subsistence purposes.

2.8.8 Allow ORV Use As Described in the Temporary Closure. This alternative would make permanent the actions described in the 120-day temporary closures implemented by the NPS in August 2005 and August 2006. The entire TUA would be closed to ORVs, except 1) the one mile long Windy Creek Trail from the park boundary to the top of the ravine leading down to Windy Creek, including the 0.5 mile long spur trail that leads to the west/southwest from the ravine; 2) the northern portion of the old roadbed that extends southwest from the Cantwell Airstrip, for approximately one mile to the top of a little knoll; and 3) the Cantwell Creek Trail, which encompasses the gravelly part of the floodplain of Cantwell Creek for about 3 1/4 miles within the park downstream of the wilderness boundary, including the section that re-enters the park near Pyramid Peak. This alternative was eliminated from further consideration because similar actions are evaluated fully in the action alternatives.

Table 2.4 Summary of Alternatives

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
Summary	Entire TUA open to ORV use by NPS qualified subsistence users for all subsistence purposes.	TUA open to off-trail ORV use by NPS qualified subsistence users only by permit for retrieval of subsistence harvested moose or caribou and for all subsistence purposes on the new Bull River Access Trail and on NPS-managed trails and routes, including those within the Bull River and Upper Cantwell Creek Floodplains. Certain closures would apply.	TUA open to ORV use by NPS qualified subsistence users for all subsistence purposes *only* on the new Bull River Access Trail and on NPS-managed trails and routes, including those within the Bull River and Upper Cantwell Creek Floodplains. Certain closures would apply. Possible winter subsistence moose hunt.	Same as Alternative 3, except the NPS would not construct the new Bull River Access Trail or allow ORV use on either the Bull River or Upper Cantwell Creek Floodplain. Additionally, the NPS would authorize ORV use for subsistence purposes on NPS-managed trails *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons.
ORV Use Off-Trail in the TUA	• Allowed for all subsistence purposes by NPS qualified subsistence users. • No limits on ORV types.	• Only by permit (with conditions) for retrieval of moose or caribou harvested by NPS qualified subsistence users (except closures) • ORV types limited to: **(1)** 4-wheel drive ORVs that are < 5.5 feet wide, < 1,000 pounds maximum gross weight, < 550 cc maximum engine size, and have no aggressive lugged/paddle tires; **(2)** track-equipped ORVs that are < 5.5 feet wide, < 1,000 pounds maximum gross weight, < 1.0 ground psi, and have no-skid steering; or **(3)** Other ORVs designed with best available technology and shown to have equal or fewer impacts than the 4-wheel drive or track-equipped ORVs described above.	• No off-trail use of ORVs for subsistence or any other purposes • NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area	• Same as Alternative 3.
ORV Use On Trails	• Allowed for all subsistence purposes by NPS qualified subsistence users on any existing trail. • No limits on ORV types.	• Allowed for all subsistence purposes by NPS qualified subsistence users only on NPS-managed existing trails: Windy Creek Access Trail; Windy Creek Bowl Trail; Cantwell Airstrip Trail • Allowed on newly constructed Bull River Access Trail. • 4-wheel drive or tracked ORVs that are < 5.5 feet wide and < 1,000 pounds maximum gross vehicle weight	• Same as Alternative 2.	• Same as Alternative 2, except: o The NPS would not construct the new Bull River Access Trail o The NPS would authorize ORV use for subsistence purposes on NPS-managed trails *only* from the week before the beginning of the fall moose and caribou hunting seasons to the end of these seasons.
ORV Use on the Bull River and Upper Cantwell Creek Floodplains	• Allowed for all subsistence purposes by NPS qualified subsistence users. • No limits on ORV types.	• Allowed for all subsistence purposes by NPS qualified subsistence users on NPS-managed trails and routes. • ORV types limited to 4-wheel drive or tracked ORVs that are < 5.5 feet wide and < 1,000 pounds maximum gross vehicle weight	• Same as Alternative 2.	• ORV use on the Bull River and Upper Cantwell Creek floodplains would not be authorized.
Closures	• No immediate closures. • Departmental regulations give the park superintendent authority to close or restrict a route or area to ORV use; however, for the purpose of analysis in this EA, no such management actions are predicted to occur under this No Action Alternative.	• Immediate closure of certain areas and trails for recovery • No ORV use during spring breakup conditions until NPS allows. • Off-trail: no ORV travel allowed across open water, on slopes greater than 20%, or across areas with saturated soils such as open wetlands, ravines and stream corridors, willow swamps, and low-shrub/open wetland mixes. If future studies find minimal impacts, then ORVs designed with best available technology may be allowed to travel across a wider area. • In the future, if ORV use must be further limited, priority given to use of ORVs on NPS-managed trails and routes only to facilitate retrieval of harvested moose or caribou • All areas and trails closed for recovery would be posted with closure signs and barriers would be placed at the start of the closed trail sections • The NPS would work to actively rehabilitate two closed trail sections to prevent ongoing degradation. Once rehabilitated, these trails would remain closed to ORV use.	• Same as Alternative 2, except all areas off of NPS-managed trails and routes would be closed by regulation to ORV use, including the "recovery closures" as described under Alternative 2.	• Same as Alternative 3, except ORV use on the Bull River and Upper Cantwell Creek Floodplains would not be authorized.
Subsistence Harvest Limits	• No immediate limits. • Though future limits could be established, for the purpose of analysis in this EA, no such management actions are predicted to occur under this No Action Alternative.	• The NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to establish subsistence harvest limits for moose and caribou as necessary to maintain natural and	• Same as Alternative 2	• Same as Alternative 2

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
		healthy populations on park lands. • The NPS would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit.		
Degradation Levels	• Monitoring would continue. • No degradation levels would be established.	• Monitoring would continue. • When monitoring shows that resource degradation is moving toward unacceptable levels or is already at such levels, management action would be taken.	• Same as Alternative 2	• Same as Alternative 2.
Zoning	• The TUA would continue to be zoned as "Backcountry Management Area B"	• During the summer and fall seasons, the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, Bull River Access Trail, and the NPS-managed trails and routes within the Bull River and Upper Cantwell Creek Floodplains all would be rezoned from "Management Area B" to "Corridor."	• Same as Alternative 2.	• During the summer and fall seasons, the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and the Pyramid Peak Trail would be rezoned from "Management Area B" to "Corridor."
The 17B Easement	• Managed as it has in the past for the following uses: travel by foot, dogsleds, animals, snowmobiles, two- and three-wheel vehicles, and small all-terrain vehicles (ATVs) (less than 3,000 pounds gross vehicle weight).	• Managed as in the past, but improved by implementing specific management prescriptions to respond to identified degraded conditions.	• Same as Alternative 2.	• Same as Alternative 2.

Table 2.5 Summary of Impacts from Alternatives

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
Level of NEPA Documentation Needed to Select Alternative	Because this alternative would have major adverse impacts, an Environmental Impact Statement is required to implement this alternative.	Because this alternative would have major adverse impacts, an Environmental Impact Statement is required to implement this alternative.	Because this alternative would not result in major adverse impacts, the NPS could select this alternative with a Finding of No Significant Impact (FONSI) and no Environmental Impact Statement is required.	Because this alternative would not result in major adverse impacts, the NPS could select this alternative with a Finding of No Significant Impact (FONSI) and no Environmental Impact Statement is required.
Soils	Actions in this alternative would have a major adverse impact on soils in the Cantwell TUA because of intense, long-term ORV use in many areas of the TUA. Those soils would be affected by direct effects such as churning and rutting, and from secondary effects such as erosion. Over the long term, the level of impacts to soils could result in degradation of soils on significant areas within the 32,159 acres of the TUA. Most impacts probably would occur on the 2,900 acres of flat (i.e., less than 20% slope) and open terrain that's most easily accessed by ORVs. The level of impacts to soils anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions in this alternative would have a moderate impact on soils in the Cantwell TUA because of widespread long-term ORV use in many areas of the TUA. An estimated 51 to 959 acres of new off-trail impacts to soils would occur over 15 years, depending on the types of landscapes driven through. Impacts would include churning and rutting, as well as erosion. In addition to these impacts, soils would be directly affected by construction on 1.7 acres for the new Bull River Access Trail, another 2.0 acres to maintain trails through the Bull River and Upper Cantwell Creek Floodplains, and by continued use on 5.8 acres of the four trails retained. NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts. As a result, overall soils impacts under this alternative are expected to be moderate. The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions in this alternative would have a moderate impact on soils in the Cantwell TUA because soils would be directly affected by construction on 1.7 acres for the new Bull River Access Trail, another 2.0 acres to maintain trails through the Bull River and Upper Cantwell Creek Floodplains, and by continued use on 5.8 acres of the four trails retained. NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts. The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions in this alternative would have a minor impact on soils in the Cantwell TUA. Soils would be directly affected by continued use of ORVs on 5.8 acres of the four trails retained. NPS management of trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts. The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified.
Vegetation (Including Wetlands)	Alternative 1 would have a major adverse impact on vegetation and wetlands because of widespread, intense, long-term ORV use in many areas of the TUA. Given that that ORV use in the TUA would increase, negative impacts to previously non-impacted lands could be widespread and common. Over the long term vegetation could be adversely impacted throughout the 32,159 acre TUA. However, most impacts probably would occur on the 2,900 acres of flat and open terrain composed of open wetlands, low shrub-open wetland mix, tussock meadows, open gravel floodplains, lightly vegetated gravel bar, open water, and upland and alpine meadows. This 2,900 acres of impact includes approximately 2,314 acres of wetland impacts. The level of impacts to vegetation and wetlands anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Under Alternative 2, adverse impacts on vegetation and wetlands would be major. Trail construction, improvement, and maintenance would adversely impact a total of 10.7 acres of primarily dwarf birch shrublands, spruce-willow/alder woodlands, willow floodplain type wetlands, successional herbaceous vegetation, and willow shrub floodplain vegetation. This total includes about 1.5 acres of wetlands. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes. Off-trail ORV use for retrieval of harvested moose and caribou could impact from 51 acres to 959 acres. The 51 acre estimate represents a scenario with primarily low intensity impacts resulting from short retrieval routes (½ mile one-way) that cross vegetation types that for the most part recover from ORV impacts within 2 to 5 years (e.g., wetland edge meadows). On the other hand, the 959 acre estimate represents a scenario with primarily high intensity impacts resulting from long retrieval routes (3 miles one-way) that cross vegetation types that for the most part	Under Alternative 3, adverse impacts on vegetation and wetlands would be moderate. Trail construction, improvement, and maintenance would adversely impact a total of 10.7 acres of primarily dwarf birch shrublands, spruce-willow/alder woodlands, willow floodplain type wetlands, successional herbaceous vegetation, and willow shrub floodplain vegetation. This total includes about 1.5 acres of wetlands. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes. If snowmobiles were used for a winter subsistence moose hunt, there is the possibility of vegetation damage from their use; however, regulations requiring adequate snow cover would minimize these impacts. The level of impact under this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that	Under Alternative 4, adverse impacts on vegetation and wetlands would be minor. Trail improvement and maintenance would cause the continued vegetation loss on a total of 7 acres within primarily dwarf birch shrublands and spruce-willow/alder woodlands, including 0.4 acres of wetland vegetation. If snowmobiles were used for a winter subsistence moose hunt, there is the possibility of vegetation damage from their use; however, regulations requiring adequate snow cover would minimize these impacts. The level of impact under this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
		recover from ORV impacts within 6 to 15 years (e.g., willow and dwarf birch shrublands). Included within this off-trail range would be between 10 and 130 acres of adverse impacts to wetland vegetation (i.e., scattered wetlands within units of floodplain slopes, willow or alder shrublands, spruce-willow/alder woodlands, willow floodplain, and lightly vegetated gravel bars). Were the upper level of impacts to be reached, this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	are key to the integrity of the park.	
Wildlife	Actions in this alternative would have a major adverse impact on moose in the Cantwell TUA because levels of harvest would increase dramatically over the current average. Sex ratios or other population parameters could be changed as a result. In addition, noise from motorized equipment would disturb wildlife in general. The level of impacts to wildlife anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year would increase above the current average of 5 moose/year. The number of harvests would be capped to maintain natural and healthy populations. Noise from helicopters, airplanes, and ORVs would disturb wildlife but is not expected to cause any population-level impacts. The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year would increase above the current average of 5 moose/year, and the number of wolves harvested would likely increase, though the number of harvests for moose and wolves could be capped to maintain natural and healthy populations. Noise from helicopters, airplanes, ORVs, and snowmachines would disturb wildlife. The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Actions proposed in this alternative would have a minor adverse impact on wildlife in the TUA because the number of moose harvested would remain close to the current average of 5 moose per year, and the number of harvests would be capped to maintain natural and healthy populations. Wolves would be negatively impacted with the addition of a winter hunt, but harvest levels would be monitored and a limit proposed to maintain natural and healthy populations. Noise from administrative use of helicopters, airplanes, ORVs, and snowmachines would disturb wildlife but is not expected to cause any population-level impacts. The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.
Water Resources	Impacts to water quality, channel morphology, and aquatic species would be minor to moderate because use of ORVs would negatively affect turbidity, bank stability, and aquatic species within the TUA; however, impacts would largely be confined to crossing sites and impacts would not affect the overall health of the moving water ecosystems. An increase in turbidity, sediment transport, suspended sediments, and sedimentation would be expected in Bull River, Cantwell Creek, Windy Creek, certain tributaries, wetlands, and possibly small ponds and lakes. Increased introduction of sediments into the TUA's water bodies would, in turn, adversely impact the relatively unexceptional fishery resources that may be present. The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Impacts to water quality, channel morphology, and aquatic species would be moderate for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the streams and tributaries in the TUA. Impacts would be minor after four years because NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, including the potential for erosion and subsequent sedimentation in water bodies. Cross-country use of ORVs would be somewhat restricted, monitoring degradation levels would mitigate damage, impacts that did occur would be confined to places where ORVs cross streams and tributaries, and impacts would not affect overall health of the ecosystem. The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Impacts to water quality, channel morphology, and aquatic species would be minor to moderate for up to four years after implementation begins. During this time, new construction and use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the streams and tributaries in the TUA. The extent of this ground surface and soil disturbance has the potential, through erosion, to generate sediments that can degrade aquatic habitats and the fish species that depend on them. Impacts would be minor after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would be prohibited, monitoring degradation levels would mitigate damage, and impacts that did occur would be confined to where ORVs cross streams and tributaries. Use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species. The level of impacts to water resources anticipated from this alternative would not result in an impairment of park	Impacts to water quality, channel morphology, and aquatic species would be minor for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the few streams and tributaries in the TUA that are adjacent to the four trails open to ORV use under this alternative. Impacts would be negligible after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would not occur, on-trail use would occur only in late summer and early fall, and monitoring degradation levels would mitigate damage. Use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species. The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
			resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	
Visitor Experience	This alternative would have moderate negative impacts to visitor experience because standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation could be approached or exceeded during the summer. These factors would degrade the quality of the park setting and would likely put this part of the park out of compliance with the zoning scheme described in the 2006 *Denali National Park and Preserve Backcountry Management Plan*. The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Negative impacts to visitor experience would be minor to moderate because the standards for Management Area B and newly-imposed Corridors would be met, although the quality of the experience would be somewhat degraded by frequent noise intrusions and encounters with other people, modern equipment, and damaged vegetation. The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Impacts to visitor experience would be minor to moderate because standards for the TUA could be approached or exceeded during winter, and the quality of the experience year-round would be somewhat degraded by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites. The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Impacts to visitor experience would be minor because standards for the TUA could be approached or exceeded during winter, and the quality of the experience would be somewhat degraded during fall by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites. The quality of the summer visitor experience would be improved by eliminating impacts from ORVs from the TUA during summer. The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.
Wilderness	Alternative 1 would cause major adverse impacts on wilderness resources because the lack of proactive management would result in two important wilderness resource values, presence of natural conditions and opportunities for solitude, being compromised by the perpetuation of existing damage and the expansion of many miles of new ORV trails throughout the TUA. The level of these adverse impacts would necessitate the re-designation of the current status of the TUA from eligible for wilderness designation to one of ineligible. The level of impacts to wilderness resource values anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Alternative 2 would result in major negative impacts to wilderness resource values within the TUA because dispersed cross country ORV use would occur throughout much of the area. Two important wilderness resource values, presence of natural conditions and opportunities for solitude, would be compromised by the perpetuation and expansion of several miles of user formed ORV trails. New trail construction would increase the presence of permanent human structures in the area. The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	Alternative 3 would result in moderate negative impacts to wilderness resource values. ORV use in areas such as the Bull River would increase. New trail development and designation of existing trails would add to the presence of permanent human structures in the area. These impacts would be somewhat offset by the recovery of currently impacted areas. Maintenance of trails would also reduce their obtrusiveness. Confining ORV use to trails or routes, and allowing damaged areas to recover, would retain eligibility for wilderness designation status for the TUA. The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.	The actions in this alternative would result in overall moderate benefits to wilderness resource values, largely due to the elimination of ORV trails, routes, and dispersed ORV travel. There would be major improvements to the presence of natural conditions and solitude due to the recovery of large areas of impact and a reduced scope of motorized use. Minor impacts to both of these values as well as the absence of human structures would remain as a result of the established system of trails. Impacts from horsepacking or the winter hunt would be negligible. This alternative would be fully consistent with the current eligibility determination for the area. The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.
Subsistence Opportunities	Actions in this alternative would have major negative impacts because subsistence moose hunting, facilitated by unrestricted ORV access, would be above a sustainable level in the TUA. Over the long term NPS qualified subsistence users would have to expend more time and effort hunting moose on non-park lands and could be affected by increasing restrictions as well as declining wildlife populations on those lands. The level of impacts to subsistence anticipated from this alternative would eventually result in a significant restriction to subsistence resources (moose).	Alternative 2 would result in minor beneficial effects to subsistence resources and opportunities because of extensive ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Enhanced access to subsistence resources and opportunities would result from identifying and maintaining trails and routes for ORV use and the provision for ORV access for moose and caribou retrieval. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term. The identified ORV trails and routes would be in good moose habitat, so for much of the subsistence hunting season (the	Alternative 3 would result in minor beneficial impacts to subsistence resources and opportunities because of improved access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Greater access to subsistence resources and opportunities would result from improvements to NPS-managed trails and routes, a new Bull River Access Trail, and improved access to the Bull River and Upper Cantwell Creek floodplains. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term and remove uncertainty for NPS qualified subsistence users. The identified ORV trails and	Alternative 4 would result in minor adverse impacts to subsistence resources and opportunities. Access would be more difficult since ORV use would be allowed only on NPS-managed trails, and only beginning one week before the opening of hunting season. Competition among hunters in the TUA would increase, especially in and near the access corridors. However, a winter hunt would provide additional subsistence opportunities, and NPS qualified subsistence users would have the option of using other hunting and retrieval methods such as travel by horseback or on foot. Monitoring and proactive management, including subsistence harvest limits for moose and caribou, would provide for sustainable harvest over the next 10-15 years.

	Alternative 1 (No Action)	Alternative 2	Alternative 3 (NPS Preferred Alternative)	Alternative 4
		last half of August and the month of September) there would be improved opportunities to hunt moose near trails. Counteracting these benefits, however, would be the restrictions on ORV use for retrieval and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term. The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.	routes would be in good moose habitat, so harvests would be expected to increase. There would also be a winter hunt extending as long as possible, which if established would provide additional subsistence opportunities. Counteracting these benefits, however, would be restrictions on ORV use and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term. The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.	The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This chapter describes the following uses and resources for the Traditional Use Area: soils, vegetation (including wetlands); water resources; visitor opportunities; wilderness; and subsistence opportunities. These subjects reflect the impact topics identified in Section 1.7.1 of this document.

3.2 SOILS

Soils information in the area of the TUA is primarily from a Natural Resources Conservation Service (NRCS) report, "Soil Survey of Denali National Park Area, Alaska, by Clark and Duffy, 2004 (NPS 2004d). This seven year soil-ecological mapping effort resulted in digital maps and descriptive products for several characteristics including climate zones, natural vegetation, permafrost areas, landforms, geomorphic processes, lithology, and soils temperature regimes, parent materials, life zones, and NRCS land classifications. Additionally, soils information is gleaned from field work done by an NPS botany/vegetation crew, mostly in the 2005 field season (Liebermann and Roland 2006).

3.2.1 Park Soils & the TUA Soils Setting

The TUA is located on the south side of the Alaska Range wholly within the *humid temperate* domain. The area is within two major soils provinces, 1) the southern marine regime influence, a soils climate subzone of Alaska Range Humid Taiga-Tundra-Meadow province, and 2) the Coastal Trough Humid-Taiga Province. Two soils sections, four subsections, and 11 ecomap landtype associations (detailed map units) are represented within these provinces and are generally described below. It is important to note that the entire TUA contains eleven detailed soils map units; however, only six units are affected by existing trails and routes within the unit (see Figure 3.1).

Section M135A—Alaska Mountains

This Section consists of steep, rugged mountain ridges separated by broad valleys. Elevation ranges from 650 feet in valleys to greater than 20,000 feet on mountain peaks. The dominant soils are classified within the Gelept Suborder of Inceptisols on mountains with the less common Orthent Suborder of Entisols on flood plains. Soils are formed primarily in colluvium with smaller areas of alluvium on flood plains. About two-thirds of the area has no soil. A substantial portion of the area is barren of vegetation.

Average annual precipitation ranges from 10 to 116 inches. Average annual temperature ranges from -8 to 30°F. Freezing conditions may occur year around.

M135A Sections include three subsections. The **Alpine Mountains Subsection** (mountains) includes sporadic permafrost, and major soil taxa consisting of Typic Eutrogelepts, Typic Haplogelolls, (Oxyaquic) Humic Eutrogelepts, and (Oxyaquic) Typic Haplogelolls. One detailed mapping unit (7MS31) exists within the TUA, but no trails are found within the unit. (See Figure 3.1: Soil Mapping Units, Trail Locations, and Trail Distances-Areas in the Cantwell TUA)

The **Glaciated Uplands Subsection** (till, outwash plains, and hills), sporadic permafrost and major soil taxa expected are: Typic Haplogelods, Typic Eutrogelepts, Typic Historthels, and Typic Histoturbels. Only one soil map unit (7TP) of this subsection type is found in the TUA, and involves portions of existing trails in the Windy Creek area. (See Figure 3.1)

The **Boreal Mountains Subsection** (mountain footslopes) involves sporadic permafrost, and major soil taxa consisting of Oxyaquic Eutrocryepts, Typic Eutrocryepts, and Typic Historthels.

One mapping unit (7MS2) of this subsection is found within the TUA with portions of trails in the Windy Creek and Bowl areas, Cantwell airstrip, and the Pyramid Peak vicinity. (See Figure 3.1)

Section M135S—South Central Mountains

This Section consists of steep, rugged mountain ridges separated by broad valleys. Elevation ranges from 650 feet in valleys to greater than 20,000 feet on mountain peaks. The dominant soils are classified within the Cryept Suborder of Inceptisols and Cryand Suborder of Andisols. Soils are formed primarily in colluvium and volcanic ash. About two-thirds of the area has no soil. A substantial portion of the area is barren of vegetation.

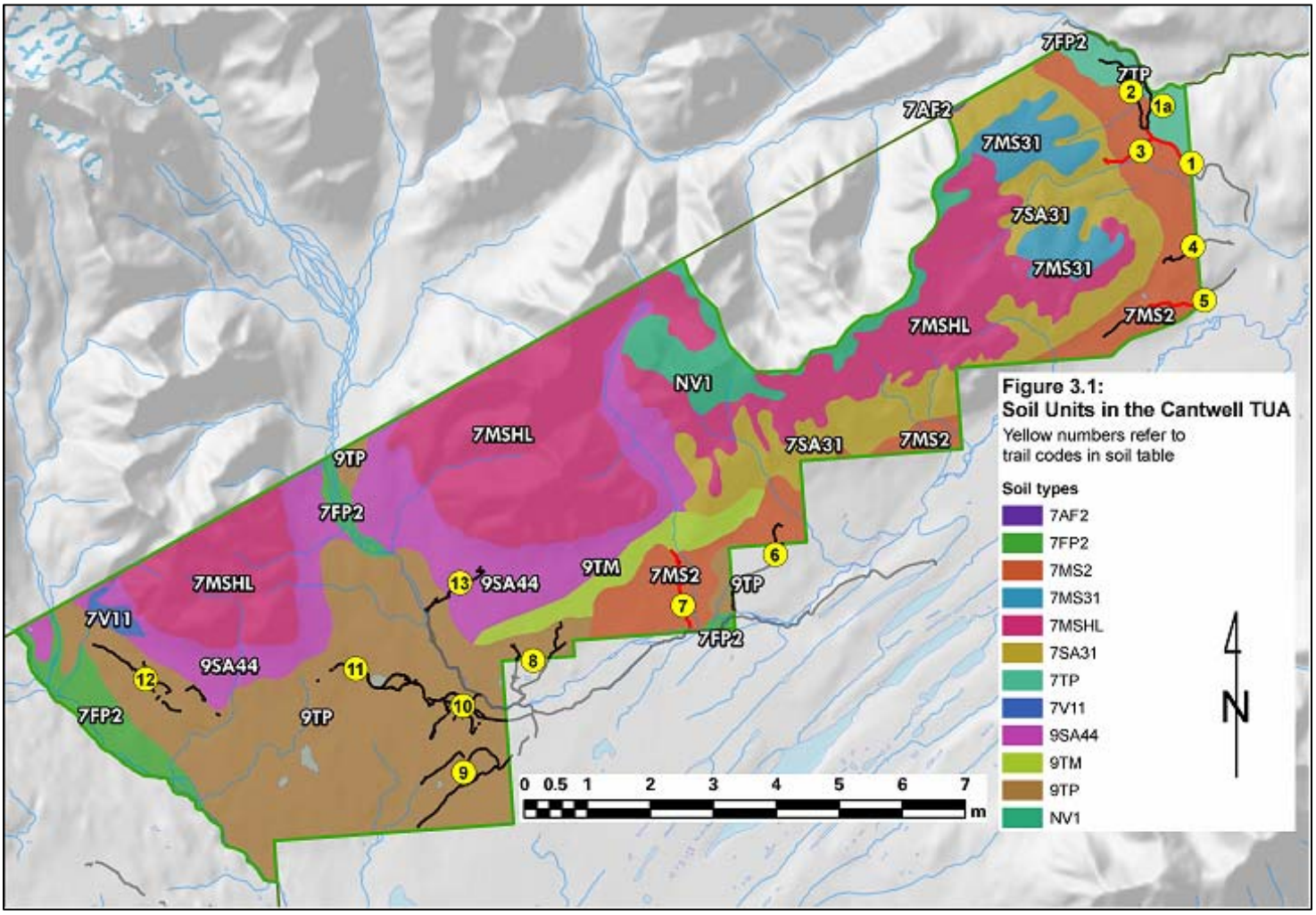
Average annual precipitation ranges from 20 to 136 inches. Average annual temperature ranges from -9 to 30°F. Freezing conditions may occur year around. Permafrost is generally absent in this section.

M135S Sections include the **Alpine Mountains Subsection** (mountains, till plains and fans) Major soils taxa include Andic Dystrocryepts, Humic Vitricryands, and Typic Humicryods, and generally no permafrost. Two mapped soil units of this subsection are within the TUA (9SA44 & 9TP) and represent a large portion of the existing trail use in the Cantwell Creek area (Figure 3.1). There are 11 Ecomap landtype associations (detailed map units).

3.2.2 Affected Soil Mapping Units and Existing Impacts

The following section discusses the existing trail and route conditions within the TUA, and ties those trails/routes with soils mapping units as mapped and described in the 2004 Soil Survey of Denali National Park Area (NPS 2004d). Figure 3.1, gives the soils units in the area, and trail lengths and disturbed areas by mapped soil unit. Table 3.1 attempts to identify the most sensitive soils by comparing physical conditions of the trails. This table uses specific trail location names/descriptions as those established by Liebermann and Roland (2006), as well as existing condition assessments as made by the Liebermann/Roland field crews. Portions of that data are used here to evaluate the soils component of the trail and route conditions. Certain collected data are itemized here to exemplify the soils impact assessment methodology:

1. Field crews GPS mapped each trail or route (or cluster of trails or routes) in the field giving them unique names for descriptive and comparative purposes. The names and associated physical parameters have been adopted here in this section as the soils database.



Trail Name →	Windy Ck Access	Windy Ck Ravine	Windy Ck North	Windy Ck Bowl	Cantwell Northwest	Cantwell Airstrip	Cantwell Northeast	Pyramid Peak	Cantwell Northwest	Cantwell W. Southeast	Cantwell West-Center	Cantwell West-Northw	Bull Riv. East	Cantwell NE Incursion	Tot Dist (feet)	Tot Area (acres)
Trail Designation	WC-CN	WC-R	WC-N	WC-SW	C-NW	CW-S	CCN-E	CCN-C	CCN-W	CCW-SE	CCW-C	CCW-NW	Bull R E	CC-NW		
Soil Map Trail Number →	1	1a	2	3	4	5	6	7	8	9	10	11	12	13		
7MS2 Linear Dist (feet)	3706	1286	4068	3828	2828	7797	1738	5845							31096	
7MS2 Area (Acres)	1.0	0.4	1.3	1.0	0.9	2.2	0.4	1.5								8.7
7TP Linear Distance (feet)	450	1929	3923												6302	
7TP Area (acres)	0.2	0.5	1.2													1.9
7SA31 Linear Distance (feet)				1276											1276	
7SA31 Area (acres)				0.4												0.3
9SA44 Linear Distance (feet)														5247	5247	
9SA44 Area (acres)														1.4		1.4
9TM Linear Distance (feet)								347							347	
9TM Area (acres)								0.1								0.1
9TP Linear Distance (feet)							578		5525	15577	23194	16942	12731	1748	76295	
9TP Area (acres)							0.1		1.4	4.6	7.1	6.1	4.1	0.6		24.0
TOTAL TRAIL LENGTH (feet)	**4156**	**3215**	**7991**	**5104**	**2828**	**7797**	**2316**	**6192**	**5525**	**15577**	**23194**	**16942**	**12731**	**6995**	**120563**	
TOTAL AREAS (acres)	**1.2**	**0.9**	**2.5**	**1.4**	**0.9**	**2.2**	**0.5**	**1.6**	**1.4**	**4.6**	**7.1**	**6.1**	**4.1**	**2.0**		**36.4**

Table 3.1 - EXISTING TRAIL & ROUTE CONDITIONS (APPLIED TO SOILS) AS OF 2005														
Trail Symbol →	**WC-CII**	**WC-R**	**WC-II**	**WC-SW**	**C-IIW**	**CW-S**	**CCII-E**	**CCII-C**	**CCII-W**	**CCW-SE**	**CCW-C**	**CCW-IIW**	**BULL R E**	**CC-IIW**
Trail Name	**WC Access**	**WC Ravine**	**WC North**	**WC Bowl**	**Cant IIW**	**Cant Airstrip**	**Cant C IIE**	**Pyramid**	**Cant C IIW**	**Cant C WSW**	**Cant C W-C**	**Cant C WIIW**	**Bull R East**	**IIE Incursion**
Trail # on Soils Map 3.1	**1**	**1a**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Trail Length (miles) →	0.8	0.6	1.5	1.0	0.5	1.5	0.4	1.2	1.0	3.0	4.4	3.2	2.4	1.3
1) Width - single vehicle	100		78	99	86	90	100	85	83	70	76	50	59	96
> single vehicle	**0**		**20**	**0**	**14**	**8**	**0**	**7**	**17**	**30**	**16**	**33**	**36**	**4**
> 12 feet	**0**		**2**	**0**	**0**	**3**	**0**	**4**	**0**	**0**	**8**	**18**	**1**	**0**
2) Parallel Paths - single	100		100	100	92	100	87	100	92	100	85	82	99	97
multiple	**0**		**0**	**0**	**8**	**0**	**13**	**0**	**8**	**0**	**14**	**18**	**1**	**3**
3) Veg Stripping - none	11			12	35	2	53	21	35	79	62	37	35	29
wheel tracks	71		74	87	51	94	35	73	50	16	32	43	62	67
more than wheel tracks	**18**	**0**	**26**	**0**	**0**	**4**	**12**	**7**	**15**	**5**	**7**	**20**	**3**	**3**
4) Soil Damage - < 6" below	98		68	100	81	81	71	93	81	97	87	66	62	76
> 6" below	**2**	**10**	**32**	**0**	**19**	**19**	**29**	**7**	**19**	**3**	**13**	**34**	**38**	**24**
5) Erosion: % of Length	**2**	**27**	**3**	**7**	**0**	**4**	**2**	**3**	**0**	**0**	**1**	**0**	**2**	**3**
6) Muddy - none to little	96		46	99	59	82	41	39	59	66	39	21	2	47
muddy	2		19	4	29	12	6	40	29	23	40	28	41	17
muddy w/ holes	**2**	**20**	**14**	**0**	**10**	**6**	**29**	**10**	**10**	**10**	**10**	**28**	**49**	**20**
degraded	**1**	**10**	**22**	**0**	**2**	**2**	**24**	**11**	**2**	**1**	**11**	**23**	**9**	**17**
7) Surface Drainage -well drained	77	26	40	100	**57**	85	11	56	57	3	2	2	0	31
poor-moderatly drained	19	36	21	0	9	6	35	32	9	28	52	23	0	25
saturated to ponded	**3**	**25**	**37**	**0**	**34**	**9**	**54**	**11**	**33**	**69**	**45**	**75**	**100**	**44**
running water	**2**	**13**	**3**	**0**	**3**	**0**	**1**	**0**	**3**	**0**	**0**	**0**	**0**	**0**
8) Slopes - 0 - 6%	97		82	58	**87**	62	98		87	99	98	91	100	
7 - 20%	3		16	26	**13**	36	2		13	1	2	7	0	
21%+	0		2	16	0	2	0		0	1	0	2	0	
Condition Index from														
bolded items above.	**20**	**105**	**159**	**7**	**90**	**55**	**164**	**60**	**107**	**118**	**125**	**249**	**239**	**118**
All figures other than condition indices are percentages of overall trail length. Data from Liebermann & Roland, 2005. Full summary field data for WC-R is not available.														

2. Nine parameters from this data set are specifically used. They are as follows:
    - Trail Length – Distance in kilometers, often involving multiple trails or routes both inside and outside the park TUA.
    - Trail width – reported as a percentage of the total length to include three categories; 1) single vehicle, **2) greater than single vehicle width, and 3) greater than 12 feet wide.**
    - Parallel Paths – reported as a percentage of the total length to include two categories: 1) single path, and **2) multiple paths.**
    - Vegetation Stripping - reported as a percentage of the total length to include three categories: 1) none (no missing vegetation), 2) wheel tracks, and **3) greater than wheel tracks.**
    - Soil Damage - reported as a percentage of the total length to include two categories: 1) Compressed less than 6´below natural grade, and **2) compressed to greater than 6" below natural grade.**
    - **Erosion** - reported as a percentage of the total length.
    - Muddiness - reported as a percentage of the total length to include three categories: 1) none to little, 2) muddy, **3) muddy with holes, and 4) degraded.**
    - Surface Drainage - reported as a percentage of the total length to include four categories: 1) well drained, 2) poor-moderately drained, **3) saturated to ponded, and 4) running water (on trail).**
    - Slope - reported as a percentage of the total length to include three categories: 1) 0-6%, 2)7-20%, and 3) >21%.
3. Nine values (**as bolded above**) from nine parameters are used as a "Trail Condition Index" for the purposes of assessing the existing impacts (see Table 3.1). The Trail Condition index figure is simply the summation of percent values for each "trail" and compares trail to trail with no regard to trail length or other measurements. Thus, the index has no units, and ranges from a low impacted value of "7" to a highly impacted value of "249." This evaluation is to be used for general guidance only, as the values and comparisons of each trail are only relative to each other trail in this EA.

3.2.3 Soil Mapping Units and Trails Contained in Each

9SA44 – Alpine Glaciated Lower Mountain Slopes

These areas generally consist of alpine-meadow mosaic (silty till) 35–70% gradient slopes, alpine scrub (gravelly till) 20 to 55% gradient slopes, and alpine dwarf scrub (gravelly till hummocks) at 15 to 55% gradient slopes. They are generally well drained, non-hydric, colluvial slopes, with an Andic Dystrocryepts, loamy-skeletal till soil taxa. Parent material is a mix of gravelly till with some silty volcanic ash, with the average sand-silt-clay percentages of the A horizon at 30-60-10%. Permeability is estimated at a moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches below the surface. Only one trail falls within this soils unit as identified below.

Cantwell Creek NW 2005 Incursion (CC-NW – Trail # 13 on Fig 3.1 Soils Map): This trail traverses a distance of 0.99 miles within the 9SA44 soil unit. The affected disturbed area (footprint) is estimated at 1.4 acres. Another 0.33 of a mile of this route passes through the 9TP soil unit. Some 44% of the entire route is described as saturated to ponded, and 37% of the route is muddy or degraded. The condition index is **118**, a low medium level of status (see Table 3.1).

9TP - Alpine Till Plains and Hills

Areas of this type include alpine-scrub meadow mosaics (silty till) 7 to 30% gradient slopes, alpine dwarf scrub (silty till) hummocks, 0 to 24% gradient slopes, and gravelly wet till (swales), at 5 to 30% gradient slopes. The scrub meadow and dwarf scrub hummocks are generally well-drained and non-hydric Andic Dystrocryepts, loamy-skeletal till, while the wet till swales are poorly drained, hydric Typic Cryaquands, medial over loamy-skeletal till. Parent material is a mix of silty volcanic ash over silty eolian deposits and/or over glacial till. The average sand-silt-clay percentages of the A horizon are 40-70-15%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches below the surface for the scrub meadow and scrub hummocks, while for the wet swales, the water table is estimated at 0 to 10 inches. Seven trails within the TUA fall into this soils unit totaling 14.4 miles distance, and occupying 24 acres of surface area, the largest soil unit representation in the TUA.

Cantwell Creek Incursion (CC-NW – Trail # 13 on Fig 3.1 Soils Map): Approximately 0.33 miles of this route traverses the 9TP soils unit, encompassing 0.6 acres of disturbance. Trail conditions are described above under 9SA44, and the condition index is **118.**

Bull River East Trails (Bull R E – Trail # 12 on Fig 3.1 Soils Map): This collection of trails involving 2.41 miles linear distance is reported wholly within the TUA and the 9TP soil unit. The area is described as saturated, swampy string-bog ground, probably of the Typic Cryaquands taxa. The field crews reported noticeable tracks (61.5% <6" deep and 38.5% > 6" deep) and a very large percentage of the route(s) as muddy and muddy with holes (89.3%). As seen in table 3.1, the Bull River East trails are 100% saturated to ponded and over 50% of the route is muddy with holes. The impact footprint involves approximately 4.1 acres, and has the second highest impact rating (**239** in Table 3.1) in the entire TUA trail system.

Cantwell Creek West-South-East: (CCW-SE – Trail #9 on Fig 3.1 Soils Map): This trail system involves a northern fork and a southern fork connected by a main stem for a total distance of 3.0 miles within the TUA. The total disturbed area is 4.6 acres. Some 69% of the route is saturated to ponded, and another 28% is poorly to moderately drained, while only 10% is described as muddy with holes, and 1.3% is degraded. The soils are likely dominate Typic Cryaquands, and are relatively sensitive soils. The Condition Index is **118**, a low medium impact value.

Cantwell Creek West Center (CCW-C – Trail #10 in Fig 3.1 Soils Map): This cluster of trails involves 4.39 miles of many paths, braids, and parallel trails Some 45% of the routes are saturated to ponded, and another 52% is poorly to moderately drained, while the muddiness is described as 10% muddy with holes, and 11% is degraded. The total length is 4.4 miles and the disturbed area is 7.1 acres. The Condition Index is **125** , a low medium impact value.

Cantwell Creek West-Northwest (CCW-NW – Trail #11 in Fig 3.1 Soils Map): This slightly braided route connects to the Cantwell West-Center trails, and involves 3.2 miles, all within the TUA and NPS lands. At least 75% of the route is saturated to ponded, and better than 50% of the route is muddy with holes or degraded. Both Dystrocryepts and Cryaquands taxa are involved. The trail is very wet, (100% saturated or ponded) very muddy (over 50% of its length is mud holes or worse degradation) and has the most parallel (braided) trails of any in the study area. The total disturbed area is estimated at 6.1 acres. The Condition Index of **249** is also the highest rating (poorest condition) for any trail in the TUA.

*Cantwell Creek North – West (CCN-W - Trail # 8 in Fig 3.1 Soils Map)***:** This system consists of two main trails totaling 1.0 miles and 1.4 acres within the TUA. The routes are described as 44%

saturated to ponded, and over 60% of it is muddy with holes. The condition index is **107,** a low medium impact value.

7MS2 – Boreal Glaciated Lower Mountain Slopes

Eight trails of the TUA are found within this soils unit involving 5.9 miles of linear distance and 8.7 acres of surface area. These areas include wet White Spruce/Willow woodlands, and White Spruce/green alder forests, in mountainous terrain with 12–45% gradient slopes. The Spruce/willow woodlands are poorly drained, silty eolian deposits over gravelly till, and classified as Oxyaquic Eutrocryepts, coarse-limy. The average sand-silt-clay percentages of the A horizon are 30-60-10%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at 20 inches.

Slightly contrasting are spruce/green alder woodlands, which are well drained, silty eolian deposits over gravelly till, and classified as Typic Eutrocryepts, loamy-skeletal. The average sand-silt-clay percentages of the A horizon are 40-70-15%, permeability is estimated at moderate to moderately rapid, and the water table (May to September) is estimated at more than 60 inches.

Windy Creek North (WC-N – Trail #2 in Fig 3.1 Soils Map): This trail is 0.77 miles long within the 7MS2 soil unit, and is entirely within the TUA. At least 40% of the route is well drained, while the rest (60%) is in poorly drained condition or saturated to ponded. Trail conditions are described as 14% muddy with holes, and 21% degraded. The disturbed area is estimated at 1.3 acres. The well-drained segment may represent the Typic Eutropcryepts, while the wetter portions could be Oxyaquic Eutrocryepts. The Condition index for this trail is **159** (table 3.1), ranking it the 4th most impacted trail in the TUA. An additional 0.74 mile of this trail is in the 7TP soils unit.

Windy Creek Southwest (WC-SW – Trail #3 in Fig 3.1 Soils Map) : This three-part trail is 0.73 miles long with the 7MS2 soil unit, and it traverses shrublands (99%) and wet spruce woodlands (1%). It is 100% well-drained, and is the only trail in the TUA that is not rated muddy and the overall condition index of **7** is the lowest impact rating of any trail in the TUA. The area disturbance coverage is 1.0 acres. An additional 0.24 miles of this trail is in the 7SA31 soil unit.

Cantwell Northwest (C-NW – Trail #4 in Fig 3.1 Soils Map): This trail leaves from the Northern Cantwell community roads to traverse westerly in dwarf birch shrublands and spruce-willow/alder woodlands. Approximately 0.54 miles of the trail is within the TUA and exclusively in the 7MS2 soil type. Surface water conditions are described as 34% saturated to ponded, 9% poorly drained, and 57% well drained. It is estimated at 30% muddy or muddy with holes. The impacted surface area of the trail is 0.9 acres. The condition index is **90**, a mid-low value.

Cantwell West-S (CW-S – Trail #5 in Fig 3.1 Soils Map) (Cantwell Airstrip): This trail leaves from the Cantwell Airstrip and traverses westerly within the TUA for 1.5 miles. The trail is estimated to be 84% well drained, 9% saturated to ponded, and 6% poorly to moderately drained. It is estimated that 6% is muddy with holes, while 0.2% is degraded. The trail disturbance area is 2.2 acres. The trail has a relatively low condition index of **55** (Table 3.1).

Cantwell Creek North-East (CCN-E – Trail #6 in Fig 3.1 Soils Map): This trail leaves from the Cantwell Creek floodplain and traverses North and East for 0.33 miles in the park and the TUA. Surface water conditions are described as 54% saturated to ponded, 35% poorly to moderately drained, 11% well drained, and 1% water running on trail. Muddiness is estimated at 29% muddy

with holes, and 24% degraded. The disturbed surface area is 0.4 acres within the 7MS2 soil type. The condition index is **164** (Table 3.1), a high medium value compared to other trails in the TUA.

Cantwell Creek North - Center (CCN-C – Trail # 7 in Fig 3.1 Soils Map): This trail leaves Cantwell Creek and traverses northwest for 1.1 miles It is described as 56% well drained, 32% poorly to moderately drained, and 12% saturated to ponded. The muddiness is estimated at 10% muddy with holes and 11% degraded. The total disturbed surface area is estimated at 1.5 acres within the 7MS2 soil unit. A small portion of the trail (0.1 mile) runs through the 9TM soils unit. The condition index is **60**, a comparatively low impact value.

Windy Creek Access (WC-CN – Trail # 1 in Fig 3.1 Soils Map): The Windy Creek access trail is a relatively well-drained route that leaves the northern Cantwell community road system toward the Northwest to reach the Windy Creek Ravine, Bowl, and North routes. The access route is approximately 0.67 miles within the TUA and involves some 0.53 acres of impact area. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be very moderate. An index figure using 4 of the usual 8 factors gives a condition index of **20**, a low values suggesting a trail of reasonably good comparable condition.

Windy Creek Ravine (WC-R – Trail #1a in Fig 3.1 Soils Map): The Windy Creek Ravine trail drops down a tributary gully toward Windy Creek from the Windy Creek Access route. The Ravine trail is approximately 0.7 miles of travel over 7MS2 soils and involves some 1.0 acres of impact area. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be moderate to medium, except for the highest susceptibility to erosion of all TUA trails inventoried. An index figure using 5 of the usual 8 factors gives a condition index of **105**, a low medium value. An additional 0.1 miles of this route traverses 7TP type soils.

<u>7SA31 Subalpine Mountain Slopes & Meadows</u>

One trail system encompasses 0.24 miles of distance and 0.4 acres of surface area in the 7SA31 soil unit. These areas include subalpine scrub slopes and meadow mosaics, and alpine scrub sedge-dwarf scrub slopes and mosaics in mountainous terrain with 8–70% slopes. Three soil types are typified here, with the slopes generally consisting of Typic Dystrocryepts, loamy-skeletal or Typic Haplogelods, loamy-skeletal taxa, and meadows and swales being Oxyaquic Eutrocryepts, coarse-loamy, drift.

Generally, the Dystrocryepts slopes (20–70%) are well drained, non-hydric soils, with a water table at more than 60 inches, with moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 30-60-10%. The Haplogeleods slopes (8–60%) are well drained, non-hydric soils, with a water table at more than 60 inches, moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 20-75-5%. The Eutrocryepts (10–50%) are somewhat poorly drained, non-hydric soils, with a water table at 4 to 20 inches and a moderately rapid permeability. The average sand-silt-clay percentages of the A horizon are 20-75-5%.

Windy Creek - Southwest (WC-SW- Trail# 3 in Fig 3.1 Soils Map, aka "bowl trail"): As described above under 7MS2, this three-part trail has one reach that traverses through the 7SA31 soils unit for 0.24 miles and involves 0.4 acres of disturbed area. It is 100% well-drained, and is not rated muddy. The condition index for this route is **7**, the lowest rating in the TUA.

7TP Alpine Slopes and Mosaics

Three trails are within the 7TP soils classification involving a combined distance of 1.2 miles, and a surface area of 1.9 acres. These areas are alpine scrub sedge gravelly till slopes, alpine scrub meadow mosaics and swales, and Alpine scrub gravelly till circles. The gravelly till slopes are at a low gradient (2–16%), and consist of Typic Historthels, loamy-skeletal taxa, which are poorly drained hydric soils, with frequent permafrost (from 12 to 24 inches below the surface) and moderate permeability until the frozen layer is reached (at ~12 inches). Typical sand-silt-clay ratios are 30-60-5. The meadow mosaics and swales are at a low gradient (2-10%), and consist of (Oxyaquic) Humic Eutrogelepts, coarse-loamy, which are somewhat poorly drained non-hydric soils, with a water table at 0 to 20 inches. Their sand-silt-clay ratios are 20-75-5.

Windy Creek - North (WC-N – Trail # 2 in Fig 3.1 Soils Map): Described above under 7MS2, this trail is 1.5 miles long, of which 0.74 miles of this length traverses the 7TP soils unit. The disturbance area in this unit is estimated at 1.3 acres. At least 40% of the route is well drained, while the rest (77%) is in poorly drained or saturated to ponded. Trail conditions are described as 14% muddy with holes, and 21% degraded. The condition index is **159,** a mid-high value for impacts.

Windy Creek – Ravine (WC-R – Trail # 1a in Fig 3.1 Soils Map): Also described under 7MS2, this trail is 0.36 miles long, with 0.5 acres of surface disturbance in the 7TP soil unit. The condition index is **105**, a relatively low value of impact, although it has the highest susceptibility to erosion of any trail inventoried in the TUA.

Windy Creek Access (WC-CN – Trail # 1 in Fig 3.1 Soils Map): As described above, this trail is 0.8 miles long, of which only 0.1 miles is in the 7TP soil type, covering 0.2 acres. Trail conditions were not summarized for this route, but the evaluation factors for trail condition index appear to be very moderate. An index figure using 4 of the usual 8 factors gives a condition index of **20**, a low values suggesting a trail of reasonably good comparable condition.

9TM Alpine and Subalpine Meadow Mosaics

Cantwell Creek North – Center or "Pyramid Peak Trail" (CCN-C –Trail # 7 in Fig 3.1 Soils Map): This trail is described above under 9TMS2, and most of the distance is contained in that soil unit. A small part (0.1 mile traverses 9TM soils, and the surface disturbance area is 0.1 acres. It is described as 56% well drained, 32% poorly to moderately drained, and 12% saturated to ponded. The muddiness is estimated at 10% muddy with holes and 11% degraded. The condition index is **60**, a comparatively low impact value.

3.3 VEGETATION (INCLUDING WETLANDS)

3.3.1 Overview of vegetation mosaic in the Cantwell Traditional Use Area (TUA)

Information on the vegetation of the TUA was obtained during a comprehensive survey of ORV use and impacts of the TUA and area conducted in 2005 (Liebermann and Roland, 2006). Vegetation mapping and delineation were done in fall 2005 using satellite imagery and low altitude aerial photography combined with fieldwork observations to identify vegetation landscape types and their susceptibility to various ORV-related influences. The vegetation classification was made by Denali staff, and is based on landscape types in the TUA that were

observed during fieldwork and are visible at the resolution of the satellite imagery; the report contains additional data on vegetation types, distribution, and impacts.

For the 2005 vegetation map, vegetation identification, boundaries, and extents are based on 1 meter resolution true-color Ikonos satellite imagery and low altitude helicopter aerial photography made during the 2005 field season. Vegetation classifications were based on vegetation associations observed during fieldwork that were visible and identifiable at the resolution of the satellite imagery and helicopter photography. A minimum single-side dimension of 50 meters was used for inclusion of vegetation features to keep the map accurate and relatively easy to read. For example, if a swale with dimensions approximately 65 by 25 meters was observed it would be mapped, but a similar feature 35 meters round would not be. Thus wider linear features were included on the map (e.g., ravines and swales), but small "outlying" features (e.g., a small wetland patch in a willow shrubland) were not.

The resulting map thus depicts ground features that were: 1) visible on the Ikonos satellite imagery, 2) were discernible on the satellite imagery (thus some vegetation types, such as saturated soil willow shrublands and mesic soil willow shrublands were not possible to differentiate in mapping), 3) are large enough in dimension to be included on the map.

Distribution of Vegetation

The landscapes of the TUA are a complex mosaic of environments varying across spatial scales (NPS 2004b, NPS 2004d, (Liebermann and Roland, 2006). Vegetation types in the area are distributed according to soil moisture, which is in turn controlled by slope and landscape position. Better-drained areas are occupied by dwarf birch- shrublands or woodlands on mineral soils, and depressions or areas of impeded drainage support open or shrub wetlands on organic soils. Areas between these extremes are occupied by transitional willow shrublands or willow-spruce woodlands.

Eastern areas of the TUA tend to have more abrupt transitions in elevation and thus vegetation transitions are sharper than the western areas. The eastern part of the TUA has higher relief than the western part, which has rolling topography. In the east, lower areas typically have dwarf birch vegetation; middle elevations spruce woodland; and higher elevations willow-alder shrubland. Vegetation in the western TUA is a complex mosaic of types that vary with more gradual topography. The predominance of wetlands on organic soils in the western part of the TUA is a conspicuous difference between these two areas.

Lower elevations are characterized by gently rolling hills and benches cut by ravines extending from the lower mountain slopes to valley bottoms. The higher areas, less likely to be used for ORV use because of their slopes and alpine habitat, rise on steep slopes to alpine rockfields. Vegetation of the region ranges from forested lowlands to rocky alpine meadows, and consists of a mosaic of systems that includes closed stands of spruce, willow and alder shrublands, willow swamps and floodplain backwaters, a variety of open wetlands, moist herbaceous meadows and swales, numerous ponds and wet depressions, and drier upland plant communities of low birch-ericaceous shrub on well-drained hills and slopes.

Photos 3.1 through 3.12 show many of the vegetation types, as well as some of the existing ORV impacts, in the TUA. Appendix 8 provides additional details about vegetation types, classifications, descriptions, and distribution within the TUA.

Photo 3.1 Well-drained soil at shrub-land transition to spruce-willow forest

Photo 3.2 Rutting and ponding in alder-spruce-willow woodland

Photo 3.3 Character of trail in upland willow-dwarf birch-spruce area

Photo 3.4 Character of trail through wet willow-dwarf birch-spruce wood

Photo 3.5 Character of wet sedge meadow

Photo 3.6 Character of trail in shrub woodland

Photo 3.7 Soil mixing, ponding, ruts and braiding on inundated sedge wetland

Photo 3.8 Mudhole on dwarf birch area

Photo 3.9 Rock outcrop vegetation (note lack of distinct path)

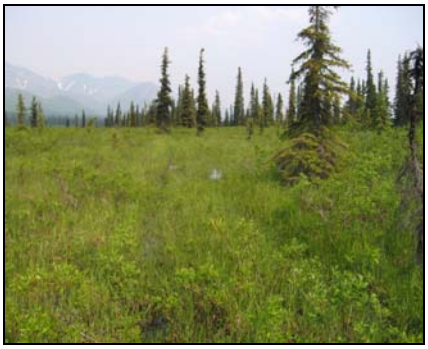


Photo 3.10 Character of trail on inundated wetland edge

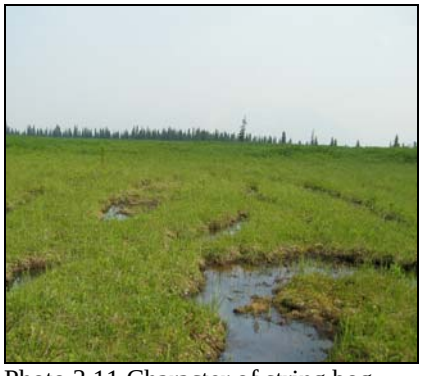


Photo 3.11 Character of string bog

Photo 3.12 Transition from willow shrub swamp to open graminoid wetland

3.3.2 Overview of Wetlands in the Cantwell Traditional Use Area

Off-Floodplain Wetlands

According to the U.S. Fish and Wildlife Service ("Cowardin") system of wetland classification (USFWS 1979), all three systems of non-saline wetlands occur within the Cantwell TUA, including riverine, lacustrine and palustrine. Wetland systems in the TUA are topographically controlled, and highly variable based on soil hydrology, vegetation, and soils. These wetland conditions change rapidly in short distances, resulting in surface durabilities that often only persist for several dozen feet before changing markedly; this has important implications for resilience to vehicle impacts. Beaver (*Castor canadensis*) also influence wetlands through their constantly changing impoundment of streams, maintenance of ponds and channels, and manipulation of vegetation. Most wetlands in the area are dominated by herbaceous plants including grasses, rushes, and sedges, and mosses. Some have willow, alder, and, less commonly, dwarf birch shrubs as an important component as well.

Wetland systems play an important ecological and geomorpholgical role in efficiently capturing and controlling precipitation and runoff from the significant snowfall and summer rains that fall on nearby slopes of the Alaska Range and channeling it to the streams and rivers of the area. They also provide preferred habitat for moose as well as desirable high-visibility hunting areas.

Numerous small ponds, swales, swamps, and open wetlands are interspersed within the forest and shrubland areas of the TUA, underlain by glacial till and colluvial and floodplain deposits. Smaller (palustrine) wetlands are a dominant vegetation feature at low elevations west of Cantwell Creek, where they occur in a mosaic with better-drained upland systems. Wetlands often alternate with upland areas because of the pattern of depressions, low ridges and ravines characteristic of this area. Because of this landscape mosaic, it is nearly impossible to travel any significant distance in the area west of Cantwell Creek without transiting through wetlands, and overland travel passes in the TUA almost always transit some wetland terrain.

A few larger lacustrine wetlands occur west of Cantwell Creek within the TUA, associated with the the larger ponds that dot this area. The largest three of these are about 8.6, 14.8, 30.9 acres in size. Riverine wetlands occur along the floodplains of Cantwell and Windy Creeks and the Bull River.

Floodplain Wetlands

Portions of three rivers are in the TUA: Cantwell Creek, Bull River, and Windy Creek. Cantwell Creek has a generally more meandering and less braided path than the other two rivers in the TUA, and thus a greater number and diversity of habitats. Bull River has a wide floodplain in the north, but a much narrower one in much of the south. It has less meander than Cantwell Creek but a higher maximum flow and greater braiding upstream, resulting in a larger proportion of the floodplain in early successional vegetation than Cantwell Creek. Windy Creek has a steeper, eroded glacial valley with little meander and thus a narrow floodplain, though some areas of floodplain and abandoned meanders support distinctive floodplain vegetation.

The water tables of the floodplains fluctuate rapidly with variations in mountain climate and runoff. Because of their diverse microenvironments and disturbance regime, floodplains have a complex mosaic of vegetation occupying varying niches of topography, hydrology, and soils. Vegetation types that are significantly different can occur in a very small area as compared to

those above the floodplain. River floodplain vegetation includes shrublands, backwater swamps, wet swales, sedge meadows, some open wetlands, and pioneer river bar communities. Primary successional vegetation of dispersed forbs and willow is common in newly abandoned channels and eroded areas, grading into often very dense thickets of willow (*Salix* spp.) and occasionally alder (*Alnus crispa*) on older surfaces. Many of these areas are wetlands or transitional to wetlands according to the US FWS classification. Numerous vegetation types were mapped as a single class on the vegetation map, because of limits in data and map scale, and they actually contain several discrete sub-types that are sufficiently unique in their hydrology, soils, configuration, and susceptibility to ORV impacts to discuss separately.

3.3.3 Plant Species of Management Concern That Occur in Area

Botrychium alaskaense occurs in river flats in this general area of Denali National Park, and thus surveys for this taxon along Cantwell Creek and Bull River should be performed before choosing designated routes through these areas.

3.3.4 Description of Specific Vegetation Types and Their Distribution in TUA

The major vegetation types found in the affected area are described in Appendix 8 and their distribution is shown in Figure 3.2. Vegetation on higher and steeper elevations where ORV use was not documented in the TUA is unlikely to be traveled on and is not included.

3.3.5 Causes and Types of Vegetation Impacts

Impact Levels

Impact levels in the TUA vary greatly by use pattern and intensity and landscape (Liebermann and Roland, 2006). Many important factors relating to ORV use and impact were not directly measured in the 2005 survey and remain estimates, including weather during and around the time of impact; vehicle speed and user behavior; number and temporal arrangement of passes; and degree of previous use, and thus damages cannot be precisely predicted further than the extension of present trends. In some vehicle path segments no lasting traces of ORV use were observed between highly degraded visible segments; for example, on open dry meadows between wetter lowlands. In other areas negative impacts may be severe and long-lasting, as on open wetlands. Where landscape transitions are abrupt, highly impacted areas can be adjacent to areas of little or no impact. Recovery times can likewise be disparate between closely adjacent areas.

3.3.6 Current ORV Impacts to Vegetation and Their Extent

Existing Vegetation Damages

Existing ORV travel areas and routes in the TUA were comprehensively inventoried and mapped in 2005, and a comprehensive report of impacts and their extent was compiled and mapped (Liebermann and Roland, 2006). Current ORV use in the TUA is primarily on a set of informal, unmarked trails of the area; these often have some peripheral branching side-trails and exploratory passes. A smaller area and number of impacts have been documented from dispersed travel on areas of the Cantwell Creek floodplain, and several single-event incursions across undisturbed land (Figure 3.1).

Extent of Impacts on ORV Travel Areas

Vegetation damage is limited to the vehicle travel path area on single-width travel passes (about 6 feet wide). Additionally, most of the trails have multiple areas that are wider than single-vehicle width, to 15 feet or, in extreme cases, 30 or more feet wide. The most extreme examples of trail widening are on the areas west of Cantwell Creek. In some cases these result from simultaneous or offset travel of two or more vehicles on discrete parallel routes; in others from drivers taking multiple discrete or overlapping passes around obstructions or trail degradations ("braiding"), and some are areas where the actual vehicle wheel path is unclear because of wide areas of damaged soils or vegetation on the trail surface; in a few cases impacts are not readily visible (e.g., the Cantwell Airstrip trail, on the rock outcrop area, as well as some sedge meadows). In these cases it is not possible to determine previous wheel placement, resulting in multiple, superimposed impacts over the area. Erosion has also spread beyond the vehicle path in some areas and impacted vegetation by removal or deposition of eroded soil.

Types of ORV Impacts

Vegetation damage or removal along the wheel paths is common on all but the least traveled ORV use areas surveyed in the TUA, and ranges from breakage of woody plant parts and compaction of herbaceous plants to soil removal and compaction, organic mat stripping, and destruction of revegetation. Heavily used and saturated areas usually have wider vegetation stripping across the vehicle path, with bare soil exposed, and in more severe cases vegetation stripping extends beyond the wheel tracks to part or all of the total trail width.

Shrub breakage and removal is the most visible type of vegetation impact resulting from ORV use in the TUA. Of the two main shrub types encountered on ORV use areas in the TUA (dwarf birch and willow), there is a difference between the nature and duration of response from ORV impacts. Willow shrublands cover much of the TUA, and all existing trails and most single-use passes cross at least some willow areas. Willows are generally larger and have more and thicker branches and thus sustain more visible morphological damage after a vehicle pass. Willows are adapted to herbivory (such as by moose), however, and thus tend to recover some vegetative form sooner than dwarf birch. Dwarf birch are generally smaller and less robustly branched than willow, and after an initial vehicle pass dwarf birch show less branch breakage than willow. However, a year or more later they show a much more visible and persistent decrease in number of branches, leafiness, and upright form across the vehicle travel path and, in particular, on the wheel contact tracks (Liebermann and Roland 2006, Sinnott 1990).

Some vegetation and plant species composition change has been observed on existing use areas in the TUA. The most prominent of these is replacement of shrub growth by herbaceous vegetation where shrubs have been impacted. On open areas of saturated soils some species changes were noted, such as higher frequency of some species, related to several factors including impacts to original vegetation and microenvironmental changes such as compression and rutting of soils and related soil moisture changes.

Visual impacts to vegetation results from a combination of vegetation and soil impacts, and were recorded in 2005 in most areas in the TUA with ORV use. The most common visual impacts are from a combination of wheel ruts into saturated soil and vegetation damage and in shrub morphology damage to willow and dwarf birch.

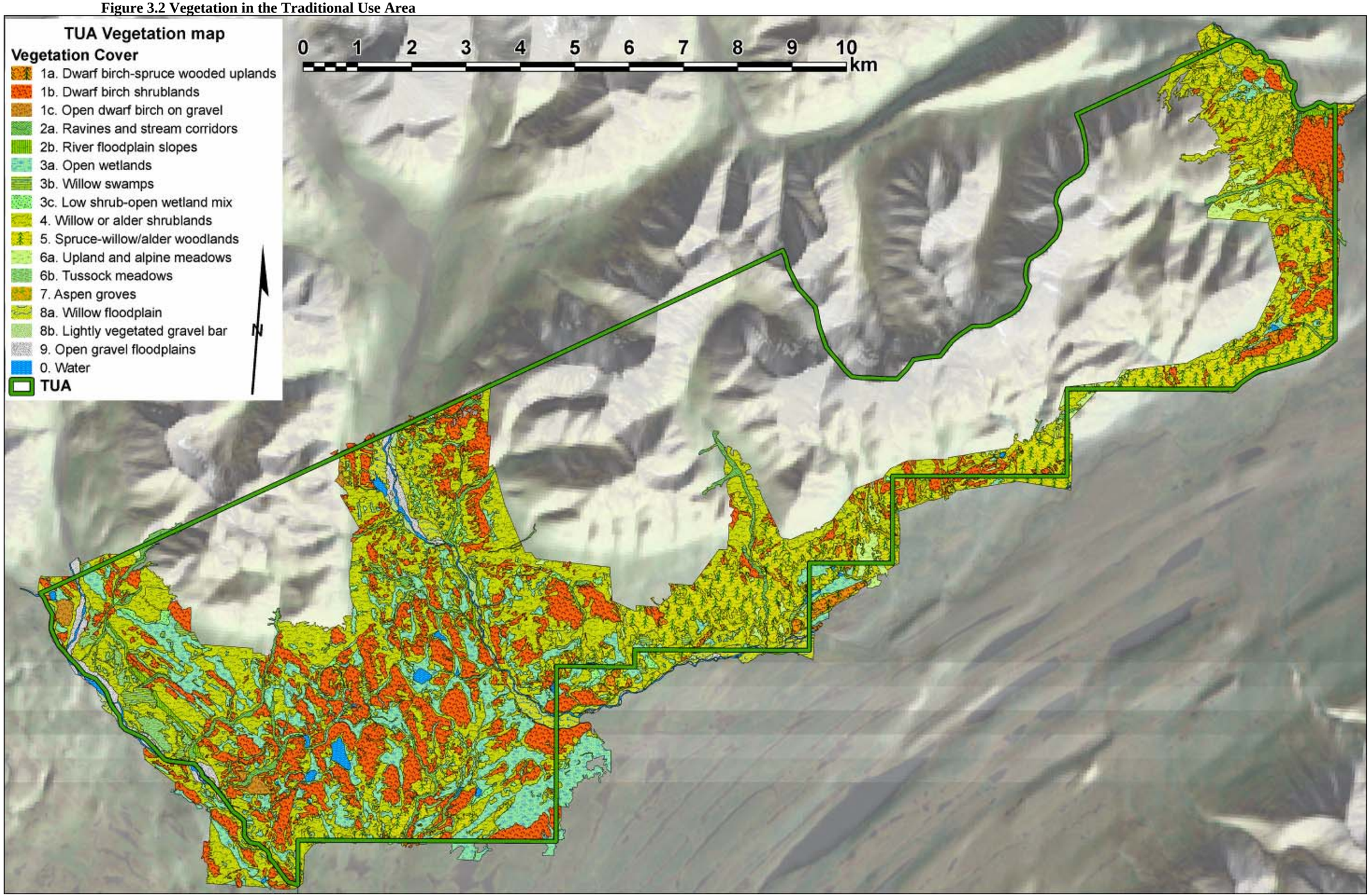
Hydrological impacts to wetlands documented in 2005 included those confined to the general vehicle path area, such as the creation of wet muddy depressions, water-filled track ruts, and extensive trail-wide water-filled "ponded" depressions. Impacts to larger areas were also found, including drainage capture of streams or overland drainage by wheel ruts or trail depressions, drainage stream widening and deepening at ORV crossing areas, and newly created drainage channels from wetlands. All of these can affect vegetation by direct removal, drowning, sedimentation, or diverting water away from areas. Hydrological changes can also affect species composition by favoring different species from the original.

In some cases access to an area created by ORV use can **facilitate non-vehicle impacts** from increased non-ORV use, such as disruption or fire rings from camps or burned areas like that observed near the Cantwell Creek West-Southeast trail (on State land). Some evidence of saw-cutting of shrub branches to facilitate vehicle access was observed in 2005 mapping on two trails. In general, these kinds of impacts were rarely observed in 2005 surveys and are thus very difficult to predict.

Table 3.2 Relative susceptibility of some common vegetation types in TUA to various forms of impacts, based on observations of existing impacts made in the 2005 TUA ORV impact field inventory.

Vegetation landscape type	mudholes and muddiness	rutting	braiding	ponding	erosion	organic mat perforation	wide trail width	vegetation stripping	rapid vegetation damage	persistent vegetation damage
	Relative susceptibility of damages by vegetation landscape type. 1: moderate, 2: likely, 3: very likely									
1a, 1b. Dwarf birch uplands	1	2	1	1	3	2	1	2	3	3
2a. Ravines & stream corridors	2	2	2	2	3	2	2	2	2	2
3a, 3c, 8a. Wetlands & wet floodplains	3	3	3	3	1	3	3	3	3	2
3b. Willow swamps	2	2	2	3	1	2	2	1	2	1
4. Mesic willow and/or alder shrublands	2	1	1	1	2	2	2	2	2	2
4, 8a. Wet willow and/or alder shrublands	2	2	2	3	1	3	3	3	3	2
5. Spruce-willow/alder woodlands	2	2	2	3	1	2	2	2	2	2
6a. Upland meadows	2	1	1	1	2	2	1	2	1	1
8b. Lightly vegetated floodplains	2	2	3	1	1	2	3	3	3	1

Figure 3.2 Vegetation in the Traditional Use Area



Extent and Distribution of Impacts

The combined linear distance of all ORV trails and passes in the TUA totaled about 22.8 miles, and the combined "footprint" area of all ORV-related impacts totaled 36.5 acres. There are also substantial additional impacted areas on State of Alaska lands immediately adjacent to the TUA. Appendix 8 provides the linear and area impacts documented by vegetation type, and Figure 3.1 shows the extent of impacts in the TUA.

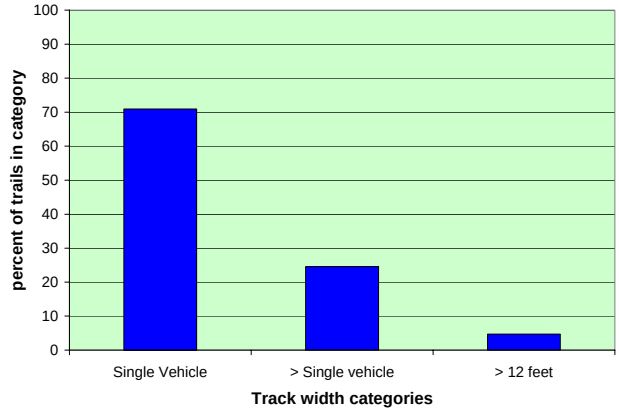


Figure 3.3. Percentages of the total linear distance of trail mapped in 2005 by trail width categories. Note that approximately 29% of all track segments mapped were wider than a single track width (wider than 6 ft.).

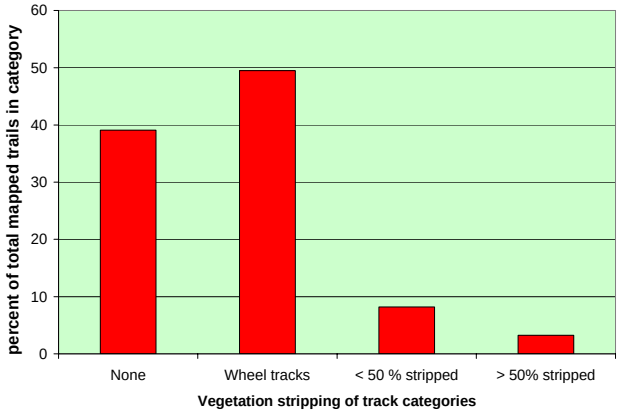


Figure 3.5. Percentages of the total linear distance of trail mapped in 2005 by vegetation stripping categories across the trail width. Note that over 60% of all trail segments mapped showed removal of vegetation from the trail.

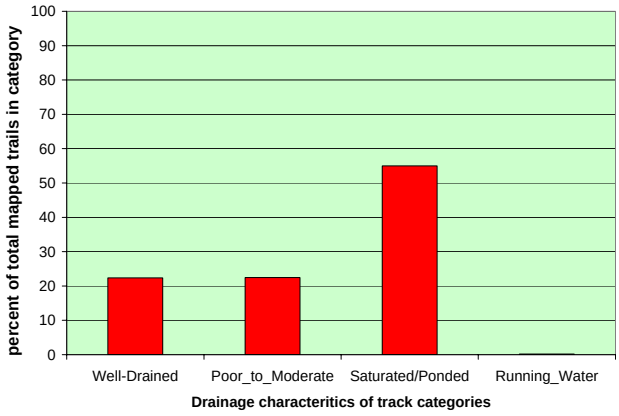


Figure 3.4. Percentages of the total linear distance of trail mapped in 2005 by drainage characteristics. Note that over 50 percent of trail length traversed areas of saturated or ponded soils, and less than a quarter of the total trail mapped was in the well-drained category. 0.6% had running water (active erosion) flowing in the trail.

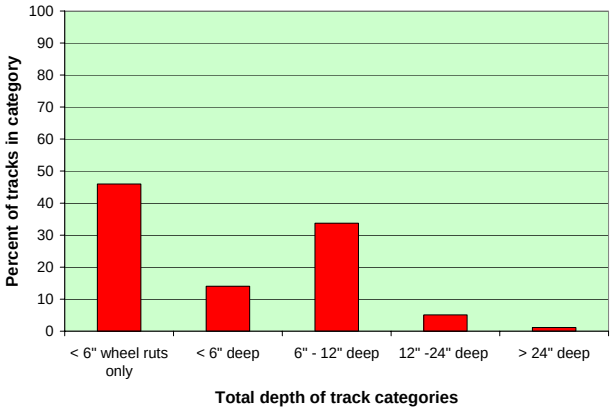


Figure 3.6. Percentages of the total linear distance of trail mapped in 2005 by total trail depth categories. Total trail depth is a measure of the total depression of the trail surface compared to the adjacent surface due to compaction, displacement, and/or erosion of soils and vegetation on the trail bed.

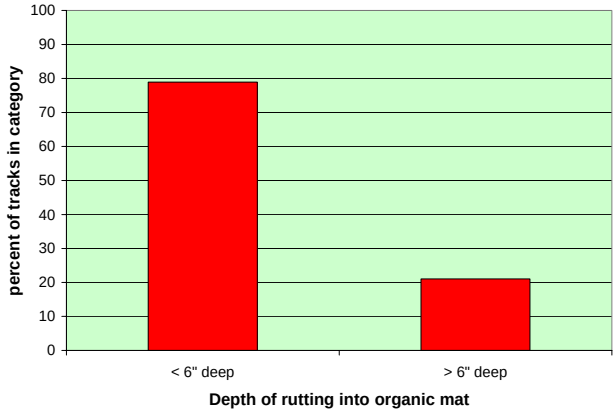


Figure 3.7. Percentages of the total linear distance of trail mapped in 2005 by soil rutting depth categories. Depth of rutting is a measure of the depth *below* the organic mat layer that the track had damaged due to organic mat perforation. In areas damaged less than 6 inches there *may* be enough remaining root and other soil matter to retain part of the organic mat's protective properties; in areas of more than 6 inches organic mat perforation is complete and the subsurface is vulnerable to increased damage.

Figures 3.3 through 3.7 include data from the 2005 survey (Liebermann and Roland 2006) from some characteristic impact indicators. These figures include trails on State lands adjacent to the TUA with similar impact and landscape characteristics, adding approximately 20% to the length of trails, though overall proportions of damages are similar to those of the TUA alone.

The most severe and widespread damages found in 2005 in the TUA were those to wetter areas, such as open and shrubby wetlands, willow and alder swamps, and river floodplain areas.

Many steeper slopes had erosion, particularly the transition slopes leaving the Cantwell Creek and Bull River floodplains, and long subalpine shrub slopes. On uplands of mineral soils and dwarf birch, the more durable ground results in trails that sustain fewer damage and remain as well-defined single passes. However, dwarf birch uplands are usually intermittent at best, though they are the common type on the Windy Creek Bowl trail and that trail is in the best condition of those surveyed.

Use of Wetlands by ORVs in TUA

There is a tendency for ORV use in the TUA and elsewhere in Alaska to gravitate to wetlands and wetland edges when those features are present on the landscape, even where no established trails exist (NPS 2004c, Liebermann and Roland 2006, Sinnott 1990). For example, the Cantwell Creek North and Cantwell Creek West areas have had intensive wetland and wetland edge paths documented across their areas, with some of the most severe rutting and similar degradations found in the 2005 survey.

Paths are often along the edges of open wetlands, where the ground is somewhat more durable but shrub growth is not as dense as further upland. Such areas are often nearly as susceptible to impacts as the wetlands themselves, however, because of the fragile herbaceous vegetation and wet to saturated soils, and many of the severe impacts were found in these areas. Impacts to wetlands vary by soil type, moisture, and vegetation cover, but in general wet areas tend to sustain much greater soil impacts and vegetation damage than drier areas (Liebermann and Roland 2006, NPS 2004c, Sparrow and Wooding 1978, NPS 1990, NPS 1998).

The 2005 survey of ORV impacts in the TUA documented that of the 22.8 miles of linear ORV impacts documented in the TUA, 12.2 miles of the total(53% of the total length) were on open wetlands and willow swamps (types 3a, 3b, and 3c as described on the vegetation map and related table in this section), and an additional 5.3 miles (23% by length) were in vegetation types that contain a high percentage of saturated areas (types 2, 4, 5, and 8a). If a conservative figure of 25% of the second group is taken as the total of saturated soil wetlands in that group, the total is 13.5 miles or 59% of the length of impacts in the TUA was on wetlands. The percentages by impacted area are similar; 19.7 acres of the first group above (54% of area) and 9.9 acres (25%) in the second group; 22 acres total wetlands impact (assuming the same 25% of wetlands in the total of the second group as above), or about 61% of the total 36.5 acres of impacts were on wetlands. These numbers are not precise as no concerted effort was made to quantify the second group into saturated/non-saturated areas; however it is likely that the 25% estimated is on the low side of the actual proportion judging from observations made during the 2005 survey.

Table 3.3: Measured and approximate wetland ORV impact areas in the TUA.

	Acres of impacted wetlands	Percentage of total impacted area in TUA	Linear miles of impacted wetlands	Percentage of total impacted length in TUA
Open wetlands and willow swamps (types 3a, 3b, and 3c)	19.7 ac	54%	12.2 mi	53%
Partial saturated areas (types 2, 4, 5, and 8a), total area	9.9 ac	27%	5.3 mi	23%
Approximate total wetland impacts (combined first and 25% of second categories)	22 ac	61%	13.5 mi	59%

Where ORV passes followed wetland edges, impacts were generally, but not exclusively, less intensive than were those when travel was closer to the center of wetlands. Many wetland transitions in the TUA are rather abrupt, and there is often very little "middle ground" between saturated or inundated areas of the wetland and heavily shrubbed more upland areas. Wetlands are thus susceptible to impact disproportionately by ORVs compared to adjacent shrublands. In many areas, extensive wetland edge passes were documented in areas even where other, more heavily used, routes were present.

Duration of Impacts

Because of the single-season nature of the ORV impact survey, without the benefit of a similar previous inventory, it is often difficult to correlate the impacts documented with a timeline of occurrence or persistence. The impacts documented in 2005 were sometimes of obvious recent creation, but more often were modified over multiple seasons. Thus determinations of the age or persistence of impacts, the number or temporal arrangement of ORV passes, driving behavior, or type of ORVs are often rough estimates.

Some previous studies on ORV impacts in Alaska, such as Ahlstrand & Racine (NPS 1990) and Sparrow, Wooding, & Whiting (1978), have attempted to document the severity and persistence of impacts based on use intensity and temporal arrangement of impact creation, though their studies investigated the impacts to tundra shrub vegetation types that only somewhat resemble those found in the TUA. Other studies in Alaska have documented the longer-term persistence of ORVs, primarily on more northern ecosystems and from larger vehicles than the 4-wheeled ORVs used in the TUA.

With the caveat above, some general ideas can nonetheless be made of the persistence of ORV impacts documented in the TUA in 2005. The general character of woody vegetation (morphology, growth on clearing edge, etc.) alongside a vehicle path can give indications of how long it has been since the initial pass was made, such as on the Windy Creek North and Cantwell Creek North trails. Most of the trails mapped in the 2005 study have been used for multiple seasons and thus the age of impacts was difficult to ascertain.

However, the severity of some types of impacts (e.g., large mudholes or multiple, wide braids) indicates that they have increased in severity over several seasons of intensive use, as ORV users have avoided difficult areas or, when hemmed in, have persistently churned through mobile soils. Areas of wide trail impacts can take longer to recover their natural vegetation after use has ceased because of the greater total area of impacts (thus often more severe) and distance to the existing unaffected vegetation, organic mat, or soil edges. A 2005 resurvey of a 2003 off-trail incursion in the Dunkle Hills area, immediately west of the TUA, showed that impacts from several intense ORV passes within a single day had readily visible lasting impacts to willow swamp, wet sedge meadow, dwarf birch shrublands, and other similar types found in the TUA.

Observations of some areas of impact in the TUA during the 2005 study indicated that vegetation and soil damages created during a few multiple passes persisted several years beyond the event; the most dramatic of these were on dwarf birch shrublands on the Windy Creek Southwest trails and the deep ruts created on wetlands of the Cantwell Creek North and Cantwell Creek West areas. Other areas, such as abandoned trail segments that had been superseded by a more recent braid, did give some insight into the persistence of severe impacts after use had ceased. The Windy Creek North trail, for example, had several abandoned braided sections in wet willow-

spruce vegetation that appeared to have quite obviously persisted for five years or more. The Cantwell Creek West-Southeast trail area, which had apparently been intensively traveled in past seasons but much less so in recent years, showed some vegetation recovery on more durable wetland edges (Liebermann & Roland 2006). There is one unusually old segment of trail, perhaps several decades old based on the growth of willow and dwarf birch vegetation that still clearly shows the presence of a trail in the Cantwell Creek West-Central area.

Effects of Climate Change on TUA Vegetation

Unknown ecological consequences are expected to result from the effects of climate change on the native ecosystems of the TUA. It is possible, or perhaps likely, that interactions between the "acute" disturbances related to ORV use and the more "chronic" stresses on the vegetation that may occur with climate change may interact in ways that impact these ecosystems synergistically. This is particularly true in the case of the potential for exotic plant introductions, which will only increase with a warmer climate, and larger numbers of users.

3.4 WILDLIFE

3.4.1 Mammals

Moose

Moose are abundant throughout the year within and near the drainages in the Traditional Use Area (TUA). They inhabit the entire vegetated TUA except tall alder shrubs, forest, and slopes greater than 20%.. Typically, moose occur in the headwaters of the draws in the TUA in August and early part of September and occur closer to the lower corridors later in September and October. Moose concentrations vary seasonally and, during winter, correlate with snow depth and timing (ADFG 1992b). Most calving takes place from late May through June. During calving, cows tend to seek areas within their home range that provide low predator densities (islands in rivers) or improved visibility (open muskeg areas) (ADFG 1996a). Post-calving moose generally move to higher elevations. Fall rutting and post-rutting concentrations occur in subalpine habitats, with moose moving down from these areas in winter as snow depths increase (ADFG 1992a). Riparian willow stands provide a large part of winter forage and upland coniferous forests provide thermal cover and shallower snow depths (ADNR 1991).

Concentrations of moose are often seen mid and late winter in the Windy Creek area above Cantwell and where Ohio Creek emerges from the mountains (NPS unpublished data). Mean density of moose during late winter (late March) ranged from 0.7 to 3.2 moose per square mile on the south side of the Alaska Range (ADFG 1990b). In the most recent NPS survey in November 2005, the entire TUA was surveyed, and 102 moose were seen. Moose were seen throughout the TUA with most of the moose seen near Cantwell Creek and 21 near Windy. This represents a mean density of 1.9 moose per square mile in the area surveyed. The bull/cow ratios show signs of stress to the population. In 200S5 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

A large rutting concentration roughly coincides with caribou calving grounds in the higher country north of Broad Pass between Windy Creek and the Bull River (ADNR 1985; ADFG 1985a). The drainages in the area of the old Dunkle Mine – the upper Bull River, Costello and

Cantwell creeks, and the West Fork of the Chulitna – are identified as prime early-winter moose range (NPS 1984; ADNR 1985).

Since 1992 the National Park Service conducted four moose surveys that encompassed the TUA. The following table shows estimates of moose per square mile, and calf/cow and bull/cow ratios. These surveys covered a 215 square mile area from Windy Creek to the West Fork of the Chulitna River.

Year	Calves per 100 Cows	Bulls per 100 Cows	Density per Square Mile
1992	29.5	29.5	1.4
1993	28.1	31.3	0.7
1995	23.6	27.6	0.9
2005	19.5	47.4	1.2

Caribou

Caribou are migratory herd animals that use varying habitats for wintering, calving (late May to early June), summer range, and rutting (September and October). The Denali caribou herd currently numbers approximately 2,000 caribou and ranges over approximately 3,900 mi^2, including most of Denali National Park and Preserve north of the Alaska Range, and areas south of the range and east of Mount McKinley. Researchers have conducted intensive studies on the dynamics of the Denali Herd since 1984 (Adams et al. 1995a; Adams 1996; Adams and Dale 1998). They found high losses of calves to predation are an important factor in limiting the growth of this caribou population. The Broad Pass area is used as winter range by the Denali herd because of good habitat and because the hill tops are wind-blown and cleared of snow.

Caribou habitat includes all land within the TUA. The Denali herd has been known to use the TUA when cow caribou drop their calves. Historically, 10–90% of the herd crossed to the Cantwell calving grounds each year for calving or immediately after calving. In the past these calving grounds may have been the most significant in terms of the percentage of the herd using them and of overall calf survival (NPS 1982; Kline et al 1983; Kline and Boertje 1984). Now, however, studies indicate the Cantwell grounds have recently been used less extensively for calving by the Denali herd than two northern areas (NPS 1989). For the last decade, approximately half of the cows in the Denali herd have calved in the foothills of Mount McKinley from the Muldrow Glacier to the Straightaway Glacier. The other half of the cows do not congregate on calving grounds but disperse throughout the range of the herd (Adams et al. 1995b). The proportion of cows on the calving grounds increases in years with low spring snowpacks and decreases when the mountains are blanketed in snow.

Following calving, caribou predominantly move to higher mountainous areas greater than 5,000 feet in elevation for the first half of the summer. These high altitude areas provide relief from insect harassment as well as nutritious, newly growing forage (Boertje 1985). By mid-summer, when insect harassment is reduced by cooler temperatures and increased rainfall, caribou disperse widely throughout the mountains and foothills of the park to forage.

With the onset of the breeding season in mid-September, caribou aggregate into rutting herds. These rutting groups can be found throughout the TUA.

In addition to caribou from the Denali herd, small numbers of caribou from the Nelchina herd venture into the TUA. The Nelchina herd, which reached about 45,500 animals in the early 1990s (ADFG 1993a), has recently declined to 36,677 animals (ADFG 2004).

Bear

Brown bears range throughout the park and preserve, but generally prefer high-elevation tall shrub, low shrub, and alpine tundra communities. Brown bear densities are poorly known for most of Denali, but recent work on the south side of the park indicates that densities there vary from 0.03–0.10 bears per square mile (ADFG 1990a, ADFG 1993b; ADFG 1996a).

Little is known about the density of black bears in Denali. In the Susitna River area, southeast of the park, black bear densities reach about 0.2 bears per square mile (Miller, et al.1987). Overall concentrations of black bears on the south side are thought to be decreasing (ADFG 1995). In contrast to brown bears, black bears prefer upland forest and floodplain forest communities below 2,000 feet in elevation (ADFG 1978a).

Gray Wolf

The size of the park's wolf population is primarily dependent on the abundance and vulnerability of ungulate prey species. During periods of low winter snowfall, when prey are in particularly good nutritional condition, wolf numbers tend to be low because of low pup production and survival and high dispersal and mortality of older wolves (Adams and Mech 1995c, Mech et al. 1998). When winters are severe, making prey more vulnerable, the wolf population can quickly increase by higher pup production and reduced dispersal of young adults. Wolves occur throughout all areas of the park that support ungulate prey (i.e., areas less than 6,000 feet elevation).

Smaller Carnivores, Rodents, Lagomorphs, and Insectivores

The TUA supports a large suite of smaller carnivores (coyote, red fox, lynx, river otter, wolverine, marten, ermine, least weasel and mink), rodents (hoary marmot, arctic ground squirrel, red squirrel, northern flying squirrel, beaver, voles, brown lemming, and porcupine), two lagomorphs (snowshoe hare and collared pika), insectivores (shrews), and at least one species of bat (little brown bat). These species inhabit a variety of habitats across Denali and form integral links in Denali's food web. Many of the rodents are prey sources for many larger omnivores and carnivores.

3.4.2 Birds

As of August 2001, 164 bird species were documented in Denali (NPS 2001). Of these, at least 106 species breed in Denali, including at least 25 resident species. The distribution of avian species in Denali is a function of habitat and elevation; however, studies of avifaunal communities are just beginning in Denali. In most cases, the available information is limited to presence and few data are available on relative abundance of species and habitat relationships.

The TUA provides habitat for many of the 164 bird species, including: migratory waterfowl such as trumpeter swans, harlequin ducks, and Tule greater white-fronted geese; raptors such as bald and golden eagles, falcons, merlins, kestrels, accipiters, northern harriers, and owls; all three species of ptarmigan; grouse; and shorebirds such as whimbrel, upland sandpiper, surfbird, semipalmated plover, yellowlegs, common snipe, solitary sandpiper, wandering tattler. The

numerous lakes and ponds at lower elevations provide important summer breeding grounds for two species that winter at sea, arctic tern and long-tailed jaeger.

3.5 WATER RESOURCES

3.5.1 Water Quality

The surface waters of Denali National Park and Preserve generally appear to be of good quality, with indications of some localized impacts from human activities (Edwards and Tranel 1998). Potential sources of contaminants are principally associated with mining claims or glacial streams that drain high-altitude mountainous areas and carry high sediment loads (NPS 1995b). Most surface waters in the backcountry receive little recreational use because of difficult access, challenging boating conditions, or lack of fisheries.

Glaciers have a profound effect on water quality and can contribute large amounts of sediments to receiving streams, significantly increasing their turbidity. Streams and rivers in which glacial melt water contributes to streamflow are referred to as glacial waters. Studies done throughout most of Denali National Park and Preserve (though not specifically in the TUA), have shown that glacial waters within DENA contain suspended sediment concentrations ranging from means of 100 to 1,400 milligrams per liter (mg/L) and turbidity ranging from means of 77 to 363 Nephelometric Turbidity Units (NTUs) (Edwards and Tranel 1998). Most of the sediment load is carried during the summer months. In non-glacial streams, streams that are not influenced by glacial melt water, suspended sediment and turbidity can vary tremendously. DENA's non-glacial streams contain suspended sediment concentrations ranging from means of 2 to 48 mg/L and turbidity ranging from means of 2 to 29 NTUs (Edwards and Tranel, 1998). The NPS does not have any information on existing contamination of water from ORV-related pollutants in Denali National Park.

3.5.2 Stream Morphology

Rivers and streams at DENA can be broadly categorized as either glacially fed or non-glacially fed. The contribution of glaciers to runoff in Alaska is considerable, and even modest contributions of glacial runoff to stream flow markedly affect the channel dynamics and flow regimes of streams and rivers (Oswood 1997). Streams of glacial origin like Cantwell Creek and Bull River are often characterized by shallow, swift flows over gravel beds, and are silty, braided, and have wide gravel floodplains filling mountain valleys. Glacier-fed rivers generally have pronounced daily and seasonal stream flow fluctuations, with large year-to-year fluctuations in flow. Typical glacial stream and river discharge in winter is very low to absent, then flows begin to rise in early May with increased solar radiation and reach a summer peak at maximum glacier melt. In contrast, non-glacial streams such as Windy Creek rise rapidly following ice breakup in early May, reaching a peak flow during breakup snowmelt by late May. An additional peak is often observed in these streams as a result of late summer storms (Milner and Petts 1994; Milner et al. 1997).

3.5.3 Benthic Macroinvertebrates

Conn (1998) identified 26 taxa of benthic macroinvertebrates in Denali National Park, including 6 families of Diptera, 6 genera of mayflies, 7 stonefly genera, and 6 Trichoptera genera. The only

non-insects found were Oligochatae worms. Overall, the benthic macroinvertebrate studies in Denali have revealed that species diversity is low while the population density is high, particularly in more stable non-glacial streams (Conn 1998). Abundance of benthic macroinvertebrates varies from year to year and certain taxa may not be found at all in some streams in all years. Such variability in macroinvertebrate abundance is likely due to channel stability, flow variability, and climatic conditions, such as snowfall. Generally, however, undisturbed streams show less variability in macroinvertebrate communities over time than streams with unstable channels.

3.5.4 Fish-supporting water bodies in the Cantwell TUA

Within the Cantwell TUA, the fisheries affected environment includes three main watercourses: Bull River, Cantwell Creek, and Windy Creek. These streams are located in two distinct river basins: the watersheds of the Susitna River and the Yukon River, respectively. Bull River is tributary to the Chulitna River, which flows into the Sustina River, and ultimately into Cook Inlet northwest of Anchorage. Cantwell and Windy creeks are both tributary to the Nenana River, which discharges into the Tenana River. The Tenana flows into the Yukon River, which empties into the Bering Sea at the Yukon-Kuskokwim Delta.

During years of high water flows, the Division of Sport Fish of the Alaska Department of Fish and Game (ADFG) reports that small numbers of returning coho salmon (*Oncorhynchus kisutch* (Walbaum)) may reach the Bull River. The river may also support some stunted Dolly Varden (*Salvelinus malma*) as well. The Bull River is glacially occluded, that is, characterized by high turbidity from suspended glacial silt and dissolved minerals. ADFG is unaware of any sport fishery that takes place on this system (Rutz, 2007).

In a recent ADFG study documenting movements of radiotagged arctic grayling (*Thymallus arcticus* (Pallus)) in the upper part of the Nenana drainage, researchers found grayling in Windy Creek throughout the summer (Gryska, 2006).

Cantwell Creek is a turbid (glacial) system and there might be some transient movement of fish species through it, but it is not expected to support any seasonal grayling residents. However, historic ADFG survey documents (1969 and 1989) indicate that there are some small lakes located within the floodplain of Cantwell Creek that contain burbot (*Lota lota*) and whitefish (as well as grayling), so it is likely those species continue to exist in the Cantwell Creek drainage today (Brase, 2007a). Specifically, these survey reports indicate that lake trout, arctic grayling, humpback whitefish, round whitefish, burbot, and sculpin were found in small numbers in five small lakes within the Cantwell Creek drainage – Duck Lake, Edes Lake, Mirror Lake, Summit Lake, and an unnamed lake – which are located 1-2 miles from Cantwell Creek itself (Brase, 2007b). Table 3.5 describes the major features of these lakes related to their fisheries.

Dolly Varden are believed to occur in lakes in the nearby Jack River, but ADFG is unaware of any documentation of their presence in either Windy or Cantwell creeks (Brase, 2007a).

There is no evidence that any of the other species of Pacific salmon – pink or humpback (*Oncorhynchus gorbuscha*), chinook or king (*Oncorhynchus tshawytscha*), chum or dog (*Oncorhynchus keta*), sockeye or red (*Oncorhynchus nerka*), and rainbow trout (*Oncorhynchus mykiss*) – occurs in the Bull River, Windy Creek or Cantwell Creek, or other water bodies (e.g. tributaries, ponds, lakes) within their watersheds.

3.5.5 Fish species potentially present in the Cantwell TUA

Arctic Grayling

The arctic grayling is a "cousin" of the trout. This freshwater fish has a prominent sail-like dorsal fin dotted with large iridescent red or purple spots. Anglers consider it one of the most unusual and beautiful sport fish of Alaska, a symbol of the clear, cold streams of the northern wilderness. Grayling are distributed throughout the Arctic as far west as the Kara and Ob rivers of Siberia and east to the western shores of Hudson Bay in Canada. Once common as far south as Michigan and Montana, they have almost disappeared from the northern U.S. because of overfishing, competition from introduced species, and habitat loss. Grayling are naturally widespread throughout Alaska, except for the Aleutians, Kodiak Island, and Southeast Alaska, where they have been artificially stocked in a few lakes (Holmes, 1994a).

Table 3.4. Features of Fish-Supporting Lakes that Drain into Cantwell Creek

Lake	Surface area (acres)	Maximum depth (ft.)	Fish species documented	Accessibility	Fishing history
Duck	35	5	GR	¼ mile S. of Alaska Hwy.	None; too shallow for realistic management
Edes	115	7	GR, WF	½ mile hike from Summit Lake	Residents from Summit and Cantwell occasionally fish for grayling
Mirror	80	35	B, GR, LT, SC, WF	1/8 mile hike from road at Summit airstrip	Summer angling for grayling and lake trout; winter angling for whitefish and burbot
Summit	400	34	GR, LT, SC, WF	1¾ mile road from Summit airstrip	Extensively ice fished for lake trout and burbot in past years; locals claim LT population has declined
Unnamed	80	14	GR	¾ mile hike from Rte. 3	unknown

B = Burbot; GR = Arctic Grayling; LT = Lake Trout; SC = Sculpin; WF = Whitefish;
Sources: ADFG (1969a); ADFG (1969b); ADFG (1969c); ADFG (1969d); ADFG (1969e); ADFG (1989a); ADFG (1989b)

Grayling have evolved a number of strategies in adapting to what are often harsh and uncertain environments. They can be highly migratory within a given watershed, using different streams for spawning, juvenile rearing, summer feeding, and overwintering. In yet other areas, they can complete their entire life without having to leave a short reach of stream or lake. Grayling usually overwinter in lakes or the lower reaches and deeper pools of medium-sized rivers, or in large glacial rivers like the Tanana, Susitna, and Yukon. They are quite tolerant of low dissolved oxygen levels, enhancing their ability to survive long winters in settings that would kill other salmonids (Holmes, 1994a).

Table 3.5 summarizes what is known about fishery resources within the Cantwell TUA:

Table 3.5. Summary of Information on Fishery Resources within the Cantwell TUA

Species	Bull River	Cantwell Creek	Windy Creek
Arctic grayling	Not believed to occur	Documented presence in lakes within watershed	Documented presence throughout the summer
Burbot	Not believed to occur	Documented presence in lakes within watershed	NA
Coho salmon	Small numbers possible during high years	Not believed to occur	Not believed to occur
Dolly Varden	May support marginal population	NA	Not believed to occur
Lake trout	Not believed to occur	Documented presence in lakes within watershed	NA
Sculpin	NA	Documented presence in lakes within watershed	NA
Whitefish (humpback and round)	Not believed to occur	Documented presence in lakes within watershed	NA

NA – No Available information but could potentially occur in low numbers

In spring, grayling migrate upstream to spawning grounds. Like salmon, this species faithfully returns every year to the same spawning and feeding areas. They spawn for the first time at 4-5 years of age and a length of about 11 to 12 inches. After spawning, they migrate once again to summer feeding areas up to 100 miles away. By the middle of summer, grayling stocks segregate themselves according to age and maturity – older adults in the upper reaches of river and stream systems, the sub-adults in the middle, and the juveniles in the lower ends. Grayling fry hatch about three weeks after spawning, and tend to occupy the quieter waters close to where they hatched. In early autumn, grayling again migrate leisurely to their overwintering areas (Holmes, 1994a).

Grayling are generalists in their food habits. Drifting aquatic insects – especially mayflies, stone flies, and caddis flies – are their primary food items. They also feed on the eggs of spawning salmon, outmigrating salmon smolts, terrestrial insects that have fallen into the water, or even an occasional vole or shrew (Holmes, 1994a).

Anglers prize grayling because any fishing technique, including bait, lures, and flies, may work at one time or another. They are especially popular because of their willingness to rise to a dry fly. Within Alaska, the largest grayling fisheries occur along the road system in the Interior.

Burbot

The burbot is the only member of the cod (Gadidae) family in fresh water in North America, and like its saltwater relatives, has mild-tasting white flesh. Burbot are distributed in fresh waters throughout North America and Eurasia southward to about 40 degrees north latitude, and occupy most large clear and glacial rivers and many lakes throughout Alaska (Holmes, 1994b).

This species has a thin, elongated body that tapers to a point near the tail. Its major distinguishing characteristics are a "chin whisker" or barbel, and dorsal and anal fins that run from the middle of the body almost to the tail. Its mouth is quite large and contains numerous rows of small, backward-slanting teeth. Burbot have mottled olive-black or brown skin interspersed with yellow patches; they appear scaleless but actually have small, almost microscopic scales. Anglers often disparage burbot as ugly, but in spite of its less than elegant appearance, it is a valuable food and recreational fish (Holmes, 1994b).

Burbot are relatively long-lived and slow-growing. It takes them about six or seven years to reach about 18 inches, the size at which most Alaska burbot spawn for the first time. They spawn under the ice in late winter (February to March) and have been observed to congregate in a large writhing ball while spawning. Their eggs are very small, and an individual female may deposit over a million of them (Holmes, 1994b).

Juveniles feed mainly on insects and other invertebrates, but by the age of five, burbot feed almost exclusively on other fish. While adult burbot may appear sluggish, they are voracious nocturnal predators. The burbot's large mouth, strong jaw, and large number of inward slanting teeth explain its efficiency as a predator. Whitefish, sculpins, lampreys, and other burbot are common food items, though small rodents or shrews may occasionally occur in the diet (Holmes, 1994b).

The most popular fishing areas for burbot in Interior Alaska are large, glacial rivers such as the Yukon and Tanana rivers. Burbot can be caught both in the summer as well as through the ice in the winter. In some areas anglers use set-lines or "trot-lines."

Coho Salmon

Also known as silver salmon, this anadromous fish is found in coastal waters of Alaska from Southeast to the Chukchi Sea and in the Yukon River to the Alaska-Yukon border. Coho are extremely adaptable and occur in nearly all accessible bodies of freshwater, from large trans-boundary watersheds to small tributaries (Elliott, 1994).

Adult cohos usually weigh 8-12 pounds and are 24-30 inches long, but individuals weighing up to 31 pounds have been caught. Adults in the ocean or recently arrived in fresh water are bright silver with small black spots on the back and on the upper lobe of the caudal fin. Spawning adults of both sexes have dark backs and heads with maroon to reddish sides; these features are more pronounced in the male. Males also develop a prominent hooked snout with large teeth called a kype. Juvenile coho salmon have 8 to 12 parr marks evenly distributed above and below the lateral line with the parr marks narrower than the interspaces (Elliott, 1994).

Coho salmon enter spawning streams from July into November, usually during periods of high runoff. The timing of the run has evolved to reflect the requirements of specific stocks. In large rivers, adults must arrive early, as they need several weeks or months to reach headwater spawning grounds. Run timing is also regulated by the water temperature at spawning grounds: where temperatures are low and eggs develop slowly, spawners have evolved early run timing to compensate; conversely, where temperatures are warm, adults are late spawners. Adults hold in pools until they ripen, then move onto spawning grounds; spawning generally occurs at night (Elliott, 1994).

The female coho digs a nest, called a redd, and deposits 2,400 to 4,500 eggs. As she deposits the eggs, the male alongside fertilizes them with milt (sperm). Eggs develop during the winter and

hatch in early spring; embryos remain in the gravel utilizing the egg yolk until they emerge in May or June. The emergent fry occupy shallow stream margins, and, as they grow, establish territories which they defend from other salmonids. During the next year or more, the fry live in ponds, lakes, pools, sloughs, and backwaters of streams and rivers, usually among submerged woody debris or submerged or emergent aquatic vegetation. From these quiet areas with little or no current, juvenile cohos dart out to seize drifting insects (Elliott, 1994).

Some coho leave fresh water in the spring and rear in brackish estuarine ponds and then migrate back into fresh water in the fall. They spend one to three winters in streams and may spend up to five winters in lakes before migrating to the sea as smolt. Time at sea varies, but most coho stay 18 months before returning as full size adults (Elliott, 1994); in that year and a half in the productive North Pacific, Gulf of Alaska, and Bering Sea, their weight may increase 100-fold.

The coho salmon supports lucrative and important commercial and sport fisheries. It is a premier sport fish and is taken in fresh and salt water from July to September. Coho are esteemed as spectacular fighters and the most acrobatic of the Pacific salmon (Elliott, 1994).

Dolly Varden

The Dolly Varden, like its close relative the eastern brook trout, belongs to a group of fish called char within the family Salmonidae. The light spots on their sides distinguish them from other salmonids like trout and salmon, which are usually black spotted or speckled. Dolly Varden are locally abundant in all coastal waters of Alaska. Anadromous and freshwater resident varieties exist, with lake, river, and dwarf populations being found among the freshwater residents. Little is known of the habits of Alaskan non-migratory Dolly Varden (Hubartt, 1994).

Dolly Varden spawn in streams, usually during the fall from mid-August to November. The female, depending on her size, may deposit from 600 to 6,000 eggs (2,500 to 10,000 in the northern form) in depressions (redds), which she excavates in the streambed gravel by digging with her tail fin. The male typically does not help with nest building but spends most of his time fighting and chasing other males. When the female is ready to deposit her eggs, the male moves to her side and spawning begins. Sperm and eggs are released simultaneously into the redd (Hubartt, 1994).

The eggs develop slowly in the cold water; hatching may occur in March, four to five months after fertilization. Dolly Varden fry rear in streams before beginning their first migration to sea. During this rearing period, their growth is slow, a fact which may be attributed to their somewhat inactive habits. Young Dolly Varden often remain on the bottom, hidden from view under stones and logs, or in undercut areas along the stream bank, and appear to select most of their food from the stream bottom (Hubartt, 1994).

Most Dolly Varden migrate to sea as smolt in their third or fourth year, but some wait as long as their sixth year, when they are about five inches long. This migration usually occurs in May or June, although significant but smaller numbers have been recorded migrating to sea in September and October. After their first seaward migration, Dolly Varden usually spend the rest of their lives wintering in and migrating to and from fresh water. At maturity, Dolly Varden return to spawn in the stream from which they originated. The fish possesses the ability to find their “home” stream without randomly searching, as was the case in their original search for a wintering area (Hubartt, 1994).

Most southern form Dolly Varden reach maturity at age 5 or 6. At this age they may be 12-16 inches long and may weigh from 1/2 to 1 pound. Dolly Varden are one of Alaska's most coveted sport fish (Hubartt, 1994).

Lake Trout

The lake trout (*Salvelinus namaycush*) is Alaska's largest freshwater fish. It is also the largest representative of the group of salmonids called char, and is closely related to Dolly Varden, eastern brook trout, and Arctic char. Lake trout have a body shape resembling that of trout and salmon. They generally have small, light, irregular shaped spots on a silvery-to-dark background; but color can vary considerably. Males and females are similar, with males having a slightly longer, more pointed snout (Bendock, 1994).

In Alaska, lake trout inhabit the deeper lowland lakes along the central Arctic coastal plain, as well as waters in the Brooks Range and Alaska Range. Lake trout inhabit clear, mountain lakes in northern Alaska as well as turbid glacial lakes on the north side of the Chugach Range and Kenai Peninsula.

Lake trout typically spend their entire lives in large, deep, cold lakes. They spawn on clean, rocky lake bottoms from September through November. Males reach the spawning sites several days before the females and use their snouts and fins to clean the substrate. Spawning occurs at night with peak activity occurring after dusk. Eggs hatch early the following spring. Little is known about the early life history of lake trout; they are believed to be reclusive while feeding on plankton as young fry. Spawning occurs for the first time at 7-8 years of age. Lake trout spawn every other year or less frequently in northern Alaska, while some southern populations may spawn annually. Lake trout growth varies depending on diet, water temperature, altitude, and genetics. The maximum size attained in some Alaskan populations probably exceeds 50 pounds, and 8-10 pound fish can be taken in many of the state's fisheries (Bendock, 1994).

The diet of lake trout varies with the age and size of the fish, locality, and the type of food available. Typical food items include zooplankton, insect larvae, small crustaceans, clams, snails, leeches, several kinds of fish, mice, shrews, and even occasional young birds. Lake trout feed extensively on other fish such as whitefish, grayling, sticklebacks, and sculpins, when available.

Most successful lake trout anglers use bright spinners or spoons while fishing from shore or near inlet and outlet streams. Natural mortality is low in most lake trout populations; however, slow growth, alternate year spawning, and older ages at maturity combine to make lake trout populations susceptible to overharvest by commercial and recreational fisheries (Bendock, 1994).

Sculpin

The slimy sculpin (*Cottus cognatus*), a bottom-dwelling fish, is found throughout most of northern United States, Canada and Alaska. It occurs in both streams and lakes, and is sometimes mistaken for a baby burbot. It is a small fish that averages about three inches in length with eyes on top of its head. It has a broad, flat head with an upper lip that protrudes past the lower lip with fine teeth on both jaws (Mansfield, 2004).

Sculpin move to shallower waters during the spawning season, which is in the spring. Males select a nesting spot under a rock or log and clean the area by fanning fine sediment and removing small pebbles with their mouths; they are territorial and can be aggressive towards other males. A male courts a female until she deposits her eggs, which are yellow to pink, on the

underside of the rock or log. The female leaves after egg deposition. Once the eggs are fertilized, the male guards his nest until the young fish are ready to leave. During this time the male fans the eggs to remove silt and provide oxygen and keeps the nest clean. The eggs hatch about 30 days after being fertilized. The sac-fry stay in the nest, usually resting on the bottom, where they remain for about a week while the yolk is absorbed. Slimy sculpin reach sexual maturity at about two years and typically live about five years (Mansfield, 2004).

The slimy sculpin is found in areas with rocky or gravel bottoms. It is nocturnal and usually spends most of its time on the stream bottom and seeks shelter under rocks and logs. It is an ambush predator, feeding primarily on insects, but also eats crustaceans, fish eggs, and small fish. Although the sculpin itself is not sought by anglers, its small size and poor swimming ability makes it a important prey item for larger fish (Mansfield, 2004).

Whitefish

As a major food item for many predatory fish, the various species of whitefish are important in the aquatic food chain. While they have potential as a sport fish, and a few small commercial fishing operations exist, their greatest use in Alaska is as a subsistence food for Natives and their dogs (Alt, 1994).

Two species of whitefish have been logged by ADFG surveys in the small lakes within the Cantwell Creek watershed: the round and the humpback whitefish (*Prosopium cylindraceum* and *Coregonus oidschian*, respectively).

Round whitefish have rounded, cigar-like bodies with tiny, pointed snouts and single nasal flaps. The upper jaw extends out over the lower. Round whitefish in most Alaskan streams rarely exceed 16 inches in length.

The humpback whitefish is referred to as a "true whitefish." Its diet consists mainly of small clams, snails, aquatic insects, larvae, and freshwater shrimp. Its head is small and the body deep or wide from stomach to backbone (Alt, 1994).

3.6 VISITOR EXPERIENCE

In the summer months, the TUA is used for recreation and other purposes by visitors to Denali National Park and Preserve. Hiking, backpacking and camping generally occurs on the Windy Creek Access Trail, on the higher elevation ridges, and along gravel bars. A backcountry permit is not required for the TUA; however, some backcountry users pass through the TUA to access adjacent units for which a permit is required. Based on the number of backcountry permits issued each year for units adjacent to the TUA, and patrol reports by rangers, park managers estimate that very few people recreate in the TUA during the summer and fall seasons (no more than two groups per week).

The availability of the opportunity to recreate in the TUA, and the quality of the visitor experience, are described in the following sections.

3.6.1 Availability of Visitor Opportunity

The TUA is located within backcountry unit 70. Hikers and backpackers typically access the TUA from Cantwell via the Windy Creek Access Trail and either exit the same way they entered

or exit the unit via Windy or Foggy Pass. Most summer recreational use in the TUA is focused in the eastern part of the unit near Cantwell.

While there are currently no limits on the number of people who can recreate in the TUA, use during all seasons is subject to guidance in the 2006 *Final Backcountry Management Plan*.

The TUA is zoned by the Backcountry Plan as Management Area B, which is described by the following standards:

- Visitors notice few if any signs of social trails, campsites, or cut or broken vegetation.
- Visitors have at most one encounter per trip with modern equipment or a landscape modification (landscape modification do not include permitted modifications for subsistence use such as cabins or trapline trails).
- There are no visible landscape mitigations for visitor use.
- No more than 5% of visitors encounter human waste, toilet paper, or litter in the backcountry.
- Natural sounds predominate in this area, but there are infrequent motorized intrusions, a few of which may be loud. Motorized noise may be audible up to 15% of any hour, and there may be as many as 10 motorized noise intrusions per day that exceed natural ambient sound. Motorized noise does not exceed 40 dBA.
- Visitors occasionally encounter other parties in these areas, but are almost always alone. They generally encounter 2 or fewer parties per day. One or two of the parties encountered may have more than 6 people.
- Visitors are always able to camp out of sight and sound of others.
- Administrative presence is generally limited to emergency activities and occasional patrols, with research and resource monitoring projects in some areas.

Based on conversations with visitors and field observations by park staff, the following conditions are assumed to exist. Natural sounds predominate in the TUA during the summer season, except during hunting season when ORVs are being used for subsistence. During the winter season natural sounds predominate in the TUA, except on a busy weekend in winter when snowmachine use is higher than normal. Visitors have at most one encounter per trip with modern equipment except during hunting season when users may encounter multiple ORVs that are being used for subsistence purposes, and during busy weekends in winter when snowmachine use is higher than normal. Visitors occasionally encounter other parties in this area but they are almost always alone, except during hunting season when they may encounter multiple parties and during busy winter weekends. Visitors are always able to camp out of sight and sound of others. Visitors typically do not encounter human waste, toilet paper, or litter.

Summer visitors notice ORV trails in the vicinity of Windy Creek, Cantwell Creek, and Bull River. The most severe ORV damage, including rutting and cut or broken vegetation from ORV use, occurs in the wetland areas that are less attractive to hikers. The level of ORV impacts varies throughout the TUA.

This is one of the more accessible areas of the park, and one that has relatively low visitation – a unique combination. Visits to this unit require self-reliance and can require a significant time commitment and specialized backcountry travel skills.

3.6.2 Soundscape

Researchers at Denali National Park and Preserve used sound level meters and digital media storage devices both to record sound level measurements in decibels (dB) and to collect digital sound recordings. Decibel levels are generally described using an A-weighted scale (dBA) to better approximate human hearing sensitivities. The sound recording stations have been used at 11 locations; the Dunkle Hills site is closest to the TUA.

Studies show that the natural soundscape of Denali National Park and Preserve varies depending on the acoustical attributes of the location. Season, animal life, vegetation, climatic conditions, topography, and proximity to water all influence the production and propagation of sounds. The TUA falls primarily in two acoustical zones (those areas with similar soundscapes): sub-alpine, and scrub/forest zones. The natural soundscape in each of these zones relies on the interplay of sound generation and attenuation (attenuation is the reduction in amplitude and intensity of a signal with respect to distance traveled through a medium).

The sub-alpine acoustical zone in Denali is vegetated by low plants. Though the natural soundscape is dominated by wind, during non-winter months, flowing water and a diversity of birds, insects and mammals are often audible. Low vegetation absorbs sound propagation but is offset by wide-open spaces that allow long distance travel from distant sound sources. Jet, propeller, and helicopter aircraft are often audible, as well as road and rail traffic near these corridors. Human voices are audible near backpacking routes and other travel and recreation corridors. Winter soundscapes differ by having fewer animal and propeller planes sounds, and no flowing water. Human-generated sounds originate from snowmachines in the TUA when there is adequate snowcover. Sound often carries long distances in this zone because of the lack of sound attenuation from vegetation.

The dominant tree species in the scrub/forest acoustical zone in Denali is a mixture of deciduous and conifers on the south side, including the TUA. The natural soundscape is less dominated by wind in this zone due to the presence of trees and scrub that block and reduce the speed of wind. Compared to other zones, animal sounds are more frequently audible. A greater diversity of birds, insects, and mammals also is heard. With the exception of aircraft sounds, audible sounds are usually generated by nearby sources rather than carried from far distances. Human-generated sounds originate from developed areas and from travel corridors near roads and railways. Aircraft are often heard overhead throughout this zone. Again, the distinction between the natural soundscapes of the acoustical zones becomes blurred during the winter months when flowing water sounds either have stopped or are muffled by snowcover and animal sounds are reduced in diversity and number.

3.7 WILDERNESS

ANILCA designated most of the former Mt. McKinley National Park as the Denali Wilderness. ANILCA also identified the protection of “wilderness resource values” and the provision of associated “wilderness recreational opportunities” to be important purposes of the park additions and preserves. A wilderness suitability review conducted as part of the 1986 General Management Plan concluded that 3.73 million acres of the park additions, including those lands within the TUA, were also suitable for wilderness designation. The conditions present in the TUA suggested that it could provide outstanding opportunities for wilderness recreation. It was also recognized that it could become a very important area for wilderness recreation within the park in the future because its proximity to major transportation corridors and the Dunkle Hills

road made it relatively accessible to the public in comparison to many other areas of the park and preserve.

NPS Management Policies direct the NPS to "take no action that would diminish the wilderness eligibility of an area possessing wilderness characteristics until the legislative process of wilderness designation has been completed." Working from the definitions given in the Wilderness Act, the provisions of ANILCA, and the tradition of wilderness preservation at Denali, the following "wilderness resource values" were identified for Denali National Park and Preserve in the 2005 Backcountry Management Plan.

- Perpetuation of natural ecological relationships and processes and the continued existence of native wildlife populations in largely natural condition
- Absence of permanent human structures, including buildings, roads, trails, dams and communications facilities
- Opportunities for solitude including:
    - Freedom from the reminders of society
    - Privacy and isolation
    - Absence of distractions such as large groups, mechanization, unnatural noise, and other signs of modern human presence

  Opportunities for primitive and unconfined recreation, which have the following characteristics;
    - Self-sufficiency, absence of support facilities or motorized transportation
    - Direct experience of weather, terrain and wildlife with minimal shelter or assistance from devices of modern civilization
    - Lack of restriction on movement; freedom to explore in the way that is desirable given conditions of weather, terrain, and personal ability; ability to be spontaneous
    - Minimal formal regulatory requirements

At the present time, these wilderness resource values are primarily affected by the extensive ORV impact that has developed away from the trail corridors that were present in the area in 1986. Snowmobile use is also a major contributor to the amount of unnatural sounds in the area, particularly on weekends during the late winter and spring. The presence of unnatural sounds from the nearby ground and air transportation corridors is also a contributing factor. The TUA remains largely free from visible presence of permanent human structures, including buildings, roads, constructed trails, and communication facilities.

Vegetation and soil damage in the form of trails from past ORV use was present when the lands within the TUA were determined to be suitable for wilderness designation in 1986. The area of the Cantwell TUA was considered to be suitable for designation in 1986 because the resource damage was largely confined to a few narrow trail corridors primarily at the northeastern edge of the TUA area. The damage associated with these trail corridors was not considered to be incompatible with possible wilderness designation in the future given the presence of trail corridors created from past use that had been incorporated into other wilderness areas. Where traditionally employed, ORV use for subsistence purposes could also occur within wilderness provided the use would not cause, or would not be likely to cause, adverse impacts to park purposes.

Subsequent ORV incursions have created widespread impacts, particularly in the open wetland areas between Cantwell Creek and the Bull River. This expansion of tracked areas since 1986 has diminished the suitability of the TUA for wilderness designation.

3.8 SUBSISTENCE OPPORTUNITIES

3.8.1 Background

One of the purposes of ANILCA is to provide the opportunity for local, rural residents engaged in a subsistence way of life to continue to do so. Accordingly, Congress provided for traditional subsistence uses by qualified local rural residents within the ANILCA additions to Denali National Park and Preserve, including the TUA. Local rural residents engage in, and depend upon, resources from the park and preserve for personal consumption, cultural identity, and to maintain a subsistence way of life.

In addition to describing the specific purposes for which Denali National Park and Preserve is to be managed, Section 202(3)(a) of ANILCA provided that "subsistence uses by local residents shall be permitted in the additions to the park where such uses are traditional in accordance with the provisions in title VIII." Under Title VIII of ANILCA, Section 811(a) states that "rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands." Subsistence access is further addressed in section 811(b) where it states that "the Secretary [of the Interior] shall permit on the public lands appropriate use for subsistence purposes of snowmobiles, motorboats and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation."

In authorizing subsistence uses within Denali National Park and Preserve additions, Congress intended that traditional National Park Service management policies be maintained which strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystem, while recognizing that subsistence use by local rural residents have been, and are now, a natural part of the ecosystem serving as a primary consumer in the food chain. In addition to providing for traditional subsistence opportunities, Congress directed the NPS to take appropriate steps when necessary to insure that consumptive uses of resources within the park and preserve not be allowed to adversely disrupt the natural balance which has been maintained for thousands of years (Senate Report p. 171, top para.).

The continuation of traditional subsistence activities depends directly on the availability of healthy and diverse wildlife, plant and fish populations. The natural diversity and abundance of resources important to subsistence activities is, in turn, directly dependent upon intact and healthy ecosystems.

On July 1, 1990 the Federal Government assumed responsibility for the management of subsistence taking of fish and wildlife on Federal public lands in Alaska. The Federal Subsistence Board (FSB) was established to oversee the Federal Subsistence Program and is the decision making body that makes rural/non-rural determinations, customary and traditional use determinations which define what communities and areas have subsistence use of wildlife populations, which species and populations are subject to harvest, when seasons open and close, how many animals may be harvested, and the method and means by which an animal may be taken. The subsistence harvest of wildlife in Denali National Park and Preserve by NPS qualified subsistence users is subject to Federal subsistence management regulations. Annually any person, agency or group may submit proposals to change Federal subsistence regulations. The Federal

Subsistence Board uses the Emergency Action process if immediate action is needed to resolve fish and wildlife issues. Emergency Actions are authorized and in accordance with 50 CFR 100.19(d) and 36 CFR 242.19(d).

The purpose of the Denali Subsistence Resource Commission (SRC) is to devise and recommend to the Secretary of the Interior and the Governor of Alaska a program for subsistence hunting within Denali National Park, and to annually recommend changes to the program. The Regional Advisory Councils review and make recommendations to the Federal Subsistence Board on proposals for regulations, policies, management plans, and other subsistence related issues on Federal public lands within the region; develop proposals pertaining to the subsistence harvest of fish and wildlife; review proposals others submit; encourage and promote local participation in the decision making process affecting subsistence harvests on Federal public lands; make recommendations on customary and traditional use determinations of subsistence resources; and appoint members to national park subsistence resource commissions.

3.8.2 Cantwell Traditional Use Area

The NPS determines eligible local rural subsistence users through the use of resident zone communities and issuance of subsistence use permits. The community of Cantwell is identified as a subsistence resident zone community containing a significant concentration of residents who have customarily and traditionally used Denali National Park lands for subsistence purposes. In 1981 after consultation with Denali's Subsistence Resource Commission (SRC), boundaries for this resident zone community were established. Resident zones authorize all permanent residents within these zones to participate in subsistence activities on NPS lands without a subsistence use permit. Individuals who reside outside of the resident zone communities, who have customarily and traditionally used park subsistence resources, may apply to the Superintendent for a subsistence use permit. Approximately 100 households qualify for subsistence use activities within the Cantwell TUA.

The number of federal registration permits issued in Cantwell in recent years (NPS 2005c):

Year	**2003**	**2004**	**2005**	**2006**
Caribou (two per applicant)	47x2	77x2	68x2	38x2
Moose (one per household)	78	88	82	36

In 1991, a decision was made that Native select lands were not federal public lands and were, therefore, closed to federal subsistence use. This closed significant portions of Cantwell Creek and Windy Creek. In 1999, fisheries regulations passed and these lands again were open to federal subsistence use. ANILCA Section 811(b) states that "...the Secretary shall permit on the public lands..." Section 102(3) defines "public lands" as Federal Lands in Alaska, to exclude validly selected State and Native Corporation lands. Thus, Section 811 did not authorize the use of ORVs on selected lands, even where found to be "traditionally employed," for subsistence purposes. It also appears that 811(a) did not authorize subsistence uses at all on those selected lands (Title II authorizations always refer to the "provisions of Title VIII"). The 1991 changeover from State to Federal management of subsistence hunting on Conservation System Units should not have changed anything. When subsistence fishing was added to federal management in 1999, the new regulations setting up the Federal Subsistence Board amended the ANILCA definition of

"Public Lands" under the authority of ANILCA Section 906(o)(2), and made the change in 50 CFR 100.4 Definition of Public Lands (2).

The State and AHTNA selected lands comprise about 70% of the TUA between Cantwell Creek and the northeast border of the TUA and less than 3% of the TUA between Cantwell Creek and the Bull River. State and Native Corporation selected lands have not been surveyed, patented or interim conveyed, and because of over-selections, they may never get transferred out of federal ownership.

The NPS determined in the 1986 Denali General Management Plan (GMP) that ORVs had not been regularly used for subsistence purposes and were not considered a traditional means of subsistence access. However, in the 1990's, eight Cantwell subsistence users and the Denali Subsistence Resource Commission (SRC) requested that the Superintendent review and reconsider the 1986 GMP determination in light of new information provided by Cantwell residents regarding their traditional use of ORVs for access to subsistence resources. In response to these requests, and in compliance with ANILCA and NPS regulations and policies, the NPS undertook a project to compile and review traditional access information for the Cantwell area. The scope of this review and report was limited to the Cantwell area because the request was specific to that community and adjacent Denali National Park lands regarding traditional subsistence ORV access for the Cantwell area.

Based on the information in the review, the National Park Service made its final Cantwell Subsistence Traditionally Employed ORV Determination (hereby incorporated by reference), in July 2005, which opened the entire Cantwell traditional ORV use area to the use of ORVs for subsistence purposes. On August 1, 2005 the National Park Service implemented a temporary 120-day closure to protect park resources in the area where Cantwell residents traditionally employed ORVs for subsistence purposes that was identified in the Determination. Three existing trails (Windy Creek Access Trail, Cantwell Airstrip Trail, Upper Cantwell Creek Floodplain Route) were exempted from this closure. The closure allowed reasonable access to subsistence resources for residents of Cantwell while protecting park resources and providing time for the National Park Service to complete the necessary field work and environmental documentation evaluating ORV effects on park resources and values. In 2006, the National Park Service implemented an identical closure.

Subsistence activities are dynamic and diverse with moose and caribou hunting usually occurring in August and September. Cantwell subsistence hunters typically look closest to home first, using Windy Creek, Cantwell Creek, then farther south in the TUA. If unsuccessful, they hunt along the Denali Highway and then Kantishna (NPS 2006c). Stricter state regulations for moose hunts on state lands, decreased moose populations on state lands, and increased competition with other hunters encourage subsistence hunters to use park lands.

Federal subsistence moose season is open August 1 – September 20, and caribou season is open August 10- September 30 and October 21 – March 31. Both hunts require a Federal registration permit. One moose permit will be issued per household. The harvest limit for moose is one antlered bull moose, and the harvest limit for caribou is two bulls. There are currently no quotas for annual unit-wide harvests of moose or caribou.

Retrieval of game occurs on foot or by ORVs used on trails that are open for such use. Most harvests are likely supported by ORV use (NPS 2005). The 2005 Cantwell Subsistence Traditionally Employed ORV Determination indicates there were a variety of corridors and routes available for mechanized access by businesses as well as local residents for subsistence into areas

that are now included within the ANILCA park additions. Information contained in the 1992 affidavits, 1993 ATV interviews and mapping, and the 2005 oral history project demonstrates there has been evolution of mechanized equipment used over time by Cantwell NPS qualified subsistence users along the primary routes along Windy and Cantwell Creek corridors, and into adjacent areas for subsistence harvests. Sections of intermittent ORV trails leading from the southwest side of Cantwell Creek into the Bull River drainage were also observed on park additions during the 1981 aerial survey.

In 2000, about 50% of the nearly 100 subsistence-eligible households in Cantwell attempted to harvest moose, with about 25% successful. Because there are so many factors involved with a successful hunt, it would be difficult to correlate ORV use with harvest levels. There is little evidence that horses have been used to retrieve game from the TUA.

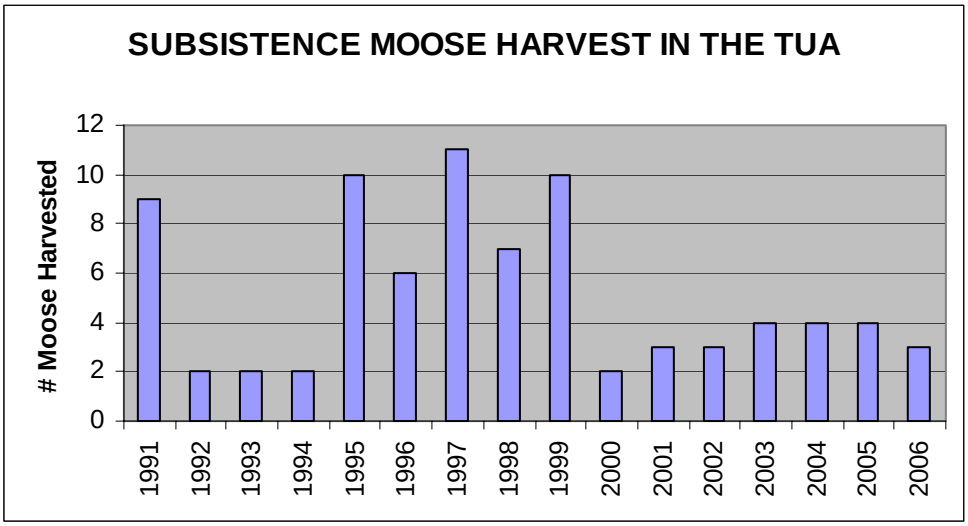
Winter hunting opportunities exist for caribou and many other furbearers and small game species. However, in recent formal and informal public meetings, eligible Cantwell residents have generally not talked about winter hunting, particularly for moose and caribou, as an important part of traditional ways.

There are traditions, among Natives and other hunters, that meat is not good in some seasons, e.g. caribou during the rut. Caribou and moose on poorer range lose fat and meat quality in late winter. But based on the widespread acceptance of the state's winter hunts for both species, and personal experience, McNay (ADFG 2006d) believes that winter meat quality is not a problem. The customary hunting practices of the late 20th century were based in part on the state's fall hunting seasons, which were in turn based on the ease of water access, ease of hunting animals during the rut, and general hunting traditions. Prehistorically, McNay (ADFG 2006d) suspects that there was a pulse of hunting activity in the fall based on water access and another in the winter based on snow travel. The state's December-January moose and caribou hunts, which are scattered around the state, are widely popular, including a winter subsistence hunt within the north side of Denali National Park in Unit 20C. In remote areas without electricity, people have often asked for hunting seasons to be moved later in the year to solve the problem of keeping meat cold (ADFG 2006d).

Figure 3.8 shows moose harvests in the Cantwell TUA from 1991 – 2006 (NPS 2006c, USFW 2007b, ADFG 2007). This information comes from NPS records maintained by the Subsistence Program Manager for Denali National Park and Preserve as well as Federal Subsistence Registration data provided by the Office of Subsistence Management at the U.S. Fish and Wildlife Service. Although Cantwell residents generally comply with reporting requirements, harvest counts could be off by as much as 15% due to underreporting or other sources of error (NPS 2006c).

Figure 3.8 shows that there has been an average of 5.1 moose harvested per year in the TUA. Harvest levels in current years have been near, or slightly above or below, sustainable levels. This can be seen by looking at total moose population in the area and bull/cow ratios. The bull/cow ratios show signs of stress to the population. In 2005 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

Figure 3.8. Subsistence Moose Harvests in Denali National Park: 1991 – 2006.



The ADF&G does not provide a caribou hunting season in GMU 20C, which includes most of the range of the Denali herd. However, a variable percentage of the Denali herd crosses back and forth over the Alaska Range. This means some of the Denali herd winters in GMU 13E, where they can be legally harvested on state and private lands by all hunters, and on ANILCA park lands -- including the TUA -- by qualified subsistence hunters.

Another subsistence activity is trapping, but this is conducted during winter by snowmachine and therefore would not be affected by the different ORV management provisions being proposed.

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4.0 ENVIRONMENTAL CONSEQUENCES

This chapter provides an evaluation of the potential impacts of each of the alternatives. For each impact topic selected for detailed analysis (see Section 1.5.1), direct, indirect, and cumulative impacts have been described. This evaluation is based on the assumption that all monitoring and mitigation would be implemented.

4.1 IMPACT CRITERIA

Summary impact levels (characterized as negligible, minor, moderate, major or impairment), are given for each impact topic and are based on the intensity, duration, and context of the impact. Definitions are provided below.

Intensity

Low:	A change in a resource condition is perceptible, but it does not noticeably alter the resource's function in the park's ecosystem, cultural context, or visitor experience.
Medium:	A change in a resource condition is measurable/observable and an alteration to the resource's function in the park's ecosystem, cultural context, or visitor experience is detectable.
High:	A change in a resource condition is measurable/observable and an alteration to the resource's function in the park's ecosystem, cultural context, or visitor experience is clearly and consistently observable.

Duration

Temporary:	Impacts would last only a single visitor season or for the duration of discreet activity, such as construction of a trail (generally less than two years).
Long term:	Impacts would extend from several years up to the life of the plan.
Permanent:	Impacts are a permanent change in the resource that would last beyond the life of the plan even if the actions that caused the impacts were to cease.

Context

Common:	The affected resource is not identified in enabling legislation and is not rare either within or outside the park. The portion of the resource affected does not fill a unique role within the park or its region of the park.
Important:	The affected resource is identified by enabling legislation or is rare either within or outside the park. The portion of the resource affected does not fill a unique role within the park or its region of the park.
Unique:	The affected resource is identified by enabling legislation and the portion of the resource affected uniquely fills a role within the park or its region of the park.

Overall Summary Impact Levels

Summaries about the overall impacts on the resource synthesize information about intensity, duration, and context, which are weighed against each other to produce a final assessment. While each summary reflects a judgment call about the relative importance of the various factors involved, the following descriptors provide a general guide for how summaries are reached.

Negligible: Impacts are generally low intensity, temporary, and do not affect unique resources.

Minor: Impacts tend to be low intensity or of short duration, although common resources may have more intense, longer-term impacts.

Moderate: Impacts can be of any intensity or duration, although common resources are affected by higher intensity, longer impacts while unique resources are affected by medium or low intensity, shorter-duration impacts.

Major: Impacts are generally medium or high intensity, long term, or permanent, and affect important or unique resources.

Impairment: A resource would no longer fulfill the specific purposes identified in the park's establishing legislation or its role in maintaining the natural integrity of the park.

4.2 CUMULATIVE IMPACTS

As defined in 40 CFR 1508.7, cumulative impacts are the incremental impacts on the environment resulting from adding the impacts of an alternative to the impacts resulting from other past, present, and reasonably foreseeable future actions, including those taken by both federal and nonfederal agencies, as well as actions undertaken by individuals. Cumulative impacts may result from singularly minor but collectively significant actions taking place over a period of time. A cumulative impacts analysis has been prepared for each impact topic under each alternative below. These analyses are based on the following list of relevant past, present, and reasonably foreseeable future actions.

- The population of the State of Alaska has steadily grown for the last 30 to 40 years, and this trend is likely to continue. Park visitation is also likely to increase over the next 20 years. According to the U.S. Census, the Cantwell population has grown from 17 people in 1939 to 183 people when ANILCA was enacted in 1980 to 222 people in the latest census in 2000. The population is expected to continue increasing.
- Since 1980, new housing and commercial development has occurred around Cantwell. The gradual development spreading out from the Parks Highway corridor is likely to continue, creating increased interest in access to the eastern and southern boundaries of the national park, particularly the park additions.
- The National Park Service and its partners have assisted in promoting winter visitation in the park entrance area by hosting an annual Winterfest that began in 2001.
- The overall number of hunters on general State lands within GMU 13E is increasing. This, combined with tightening of regulations for hunting on these State lands, increases the competition for subsistence opportunities.
- ORV use has been unlimited on State land adjacent to the TUA, and ORVs are likely to continue to be allowed on these lands in the future.
- Past motor vehicle use in the TUA has resulted in the loss of 14.8 ha (~37 acres) of vegetation.
- ANILCA allows snowmachines for subsistence, for traditional activities, and for travel to and from villages and homesites (ANILCA 811 and 1110). During the 1990s, technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali. Accurate estimates of snowmachine users are difficult to make, but during

March and April of 1999, the NPS estimated that there were between 1,500 and 2,000 snowmobile users along the Parks Highway, primarily in the region from Cantwell to the West Fork of the Chulitna River and the Tokositna River area (NPS 2000a).

4.3 EFFECTS ON SOILS

4.3.1 Soils Impact Methodology

Soils information in the area of the TUA is primarily from an NRCS report, "Soil Survey of Denali National Park Area, Alaska, by Clark and Duffy, 2004 (NPS 2004d). This seven year soil-ecological mapping effort resulted in digital maps and descriptive products for several characteristics including climate zones, natural vegetation, permafrost areas, landforms, geomorphic processes, lithology, and soils temperature regimes, parent materials, life zones, and NRCS land classifications. Additionally, soils information is supplemented by field work done by an NPS botany/vegetation crew, mostly during the 2005 field season (Liebermann and Roland 2006).

4.3.2 General Impacts of ORVs on Soils

Native soils are impacted primarily as a function of how ORV use affects the support or growth of vegetation (in non-barren areas). Thus, soils impacts occur where surface or subsurface disturbance is to the degree that the soils no longer support local plant life, or the disturbance alters the existing plant community. These impacts are usually of a mechanical nature (stripping, shearing, abrasion, compaction, hydraulic mixing), although chemical changes (i.e. changes in pH, CaCo3 …) can also alter the soil character. Both mechanical and chemical changes to soil are greatly amplified by a change in water regime that affects hydration and oxidation/reduction.

Where a surface area is used as a trail or other travel route, soils "impacts" are actions that degrade the operational utility of the surface (as a trail) by weakening the structural integrity of the soils through mechanical, chemical and/or hydrological change. It should be emphasized that most degraded soils conditions develop in areas of excessive water or poorly drained areas when traversed by trails or other human use. Soil degradation may then be defined as the condition where trail use exceeds soils resilience, creating such problems as extensive rutting, erosion, muddy sections or ponding that may require formal or casual re-routing that expands the impact to adjacent areas, or to mitigate the problem areas by proper engineering and construction.

Potential soils and other resource impacts related to trail use in Alaska are well covered in a USDA Forest Service document entitled "Managing Degraded Off-Highway Vehicle Trails in Wet, Unstable, and Sensitive Environments" (Meyer 2002). Meyer provides a useful description of soil impacts and trail degradation:

> "Direct mechanical impact has several components: abrasion, compaction, shearing, and displacement. Abrasion strips surface vegetation and roots. Compaction reduces soil voids and causes surface subsidence. Shearing is the destructive transfer of force through the soil. Displacement results in the mechanical movement of soil particles. "
>
> "Indirect impacts include hydraulic modifications, such as the disruption of surface water flow, reductions in infiltration and percolation, surface ponding, and the loss of water-holding capacity. Other indirect impacts include those associated with erosion--both the loss of soil particles by wind or water erosion and deposition of transported particles. An

associated impact is the hydraulic pumping that occurs when a destructive flow of water is forced through a saturated soil."

ORV impacts to soils involves any disturbance that changes, prohibits or degrades the natural conditions of the area (plant growth, water regime, or the natural soil stratigraphy), or involves any disturbance that changes, prohibits or degrades the practicability of traversing the area.

4.3.3 Impacts of Alternative 1 (No Action)

The primary mechanisms of soils impact in the TUA are from ORV wheel contact (abrasion, shearing, compression, displacement), damages to soils from impact (compaction; mixing; burying; and abrading), and secondary effects from the effects on impacted soils (erosion, deposition of eroded material, ponding). A summary of the agents, nature, and extent of ORV impacts is given in the General Soils Impact section above and in Liebermann & Roland (2006) for the 2005 survey of ORV impacts in the TUA, and Sinnott (1990) and Meyer (2002) for Alaska in general

Under Alternative 1, it is expected that ORV travel initially would continue to occur on most of the trails of the TUA, into non-impacted off-trail areas, and with occasional repeat travel over routes that were previously single-event off-trail paths. Travel on the Cantwell Creek and Bull River Floodplains also would be expected, and travel on some areas of the Windy Creek Floodplain is a possibility. Soils impacts could be expected both on-and off trail, intensifying in previously impacted areas and expanding to non-impacted areas in the TUA. Although style and frequency of trail use are impossible to predict, even continued use levels as occurred in the past would further tax the soils. With those continued historical use levels, and the sensitive soils involved in most of the TUA trail areas, implementation of Alternative 1 would result in the continuation of the same or similar impacts (see Table 3.1).

The 2005 inventory identified and estimated a minimum total of 36.5 acres of combined ORV impact of all types in the TUA stretching over 22.8 miles of linear distance, ranging from lightly visible travel paths to intense degradation. This area does not consider impacts off the trail or route area, such as erosion or sedimentation; it is the "footprint" of the ORV use. The greatest ORV impacts were found in wetland areas (Liebermann & Roland 2006), where vegetation and soils can be severely impacted by a single pass (NPS 1990, Sinnott 1990, Meyer 2002). These impacts would be expected to continue under this alternative. Increased trail use overall within the TUA might be most noticeable in areas of the greatest existing impacts as ORV drivers try to go around the old or newly evolving trouble spots, however correlations with certain soil types is not possible given the existing impact data (Table 3.1 and Figure 3.1)

Two trails (and associated off-trail areas) would be especially susceptible to the types of impacts described above. The Cantwell Creek West – Northwest trail (CCW-NW) involves 6.1 acres, while the Cantwell Creek West – Center trail (CCW-C) involves 7.1 acres, for a total of 13.2 acres of trail (see Figure 3.1 – Soils Mapping Units). The landform/soils involved are of the 9TP classification, with typical wet meadows and string bogs (very high water table) and mixed hydric soil conditions which are very susceptible to compaction, shearing, and hydraulic pumping. Lands of this type are generally characterized as wetlands, and as present conditions are assessed, are the highest impacted areas of the TUA.

Under this alternative, a number of factors would contribute to an expected increase in soil impacts off of the trails and areas mapped in 2005. The 2005 Determination that ORVs were traditionally employed in the TUA would serve as the basis for allowing ORV use anywhere in

the TUA for any subsistence-related purpose. Use levels would increase as this reduced regulatory ambiguity would encourage more NPS qualified subsistence users to operate ORVs in the TUA, including an authorization to leave the existing trails. The uses would not be restricted to hunting moose, caribou, and ptarmigan late in the summer, as hares, for example, are always in season. Firewood gathering, berry picking, and even scouting for game are other activities related to a subsistence lifestyle that would be supported by ORV use. Since there would be no restriction on types of ORVs or where they could be driven within the TUA, and because there would be no restrictions related to the condition of the soil or the weather, there would be an increased level of damage to the soil resources within the TUA due to increased travel through and damage to wetlands, increased parallel trail formation while evading trail obstacles, and increased occurrence and intensification of indirect impacts.

The amount of damage cannot be accurately predicted due to the unlimited amount of activity allowed under this alternative, but over the long term could result in degradation of soils on significant areas within the 32,159 acres of the TUA. However, most impacts probably would occur on the 2,900 acres of flat (i.e., less than 20% slope) and open terrain that's most easily accessed by ORVs (e.g., the open wetlands, low shrub-open wetland mix, tussock meadows, open gravel floodplains, lightly vegetated gravel bar, open water, and upland and alpine meadows).

Some foot travel for subsistence use can be expected for a small number of trails. Some further amount of soils damage could be realized by the method(s) chosen for retrieval of harvested game including use of horses. Horses can churn the soil strata, especially in sensitive soils. However, horse traffic is expected only during the hunting season, in limited numbers, and the use would create narrower travel corridors, resembling natural use from moose and caribou.

Cumulative Impacts

In addition to the current local use of the TUA trails and off-trail areas by subsistence permittees, there are other factors which could result in additional impacts to soil resources in the TUA.

The State population has steadily grown for the last 30 – 40 years, and this trend is likely to continue. Park visitation is also likely to increase over the next 20 years. Visitor use activities which would increase over the next 20 years would likely include summer hiking and horseback riding, while current or potential winter activities such as dog mushing and snowmachining would also increase. The summer activities can provide direct impacts to soils resources while other activities (snow machining, and mushing) can indirectly and more subtly affect the soils by snow compaction and subsequent alteration of the spring melt or on-site water regime. Sensitive soils, such as those of the TUA are quickly altered by nearly any changes in the natural environment.

Overall, Alternative 1 would result in major additional adverse impacts. The cumulative impact of Alternative 2 on soil resources coupled with any past, present, and future actions would likely be major.

Conclusion

Actions in this alternative would have a major adverse impact on soils in the Cantwell TUA because of intense, long-term ORV use in many areas of the TUA. Those soils would be affected by direct effects such as churning and rutting, and from secondary effects such as erosion. The level of impacts to soils anticipated from this alternative would be widespread and difficult to predict but over the long term could result in degradation of soils on significant areas within the

32,159 acres of the TUA. Most impacts probably would occur on the 2,900 acres of flat (i.e., less than 20% slope) and open terrain that's most easily accessed by ORVs.

The level of impacts to soils anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park, including the preservation of lands and waters for present and future generations, preservation of scenic values, the maintenance of sound habitat for wildlife, and the preservation of extensive unaltered ecosystems in their natural state.

4.3.4 Impacts of Alternative 2

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on the following NPS-managed trails and routes: the existing Windy Creek Access (WC-CN), Windy Creek Bowl (WC-SW), Cantwell Airstrip (CW-S), and Pyramid Peak (CCN-C) Trails; the Bull River Access Trail (new construction); and on the Upper Cantwell Creek and Bull River Floodplain Trails/Routes. The 17b easement through Ahtna Inc. property in the Windy Creek area would continue to be managed as it has in the past but would be improved to mitigate impacts.

Table 4.1 Lengths & Areas for Four Trails Authorized by Alternative 2

Pyramid Peak T.	Windy Ck Access	Windy Ck Bowl	Cantwell Airstrip	Totals
1.2 miles	0.8 miles	0.5 mile	1.5 miles	4 miles
1.6 acres	1.2 acres	0.8 acres	2.2 acres	5.8 acres

Under Alternative 2, the four existing trails managed for continued subsistence ORV use would provide 4 miles of trail length (5.8 acre footprint) for ORV travel. The great majority of these trail areas involve the 7MS2 soils, which are generally eolian deposits over gravelly till, are poor to well drained and non-hydric, and have water tables at depths up to or greater than 18 inches. Three secondary soils units are also involved (7SA31, 9TM, and 7TP) with the majority falling into the 7TP unit. These soils are variously organic material over silty eolian deposits over gravelly till, are mostly poorly drained, are both hydric and non hydric, have shallow water tables (0 to 48 inches), and the 7TP discontinuously contains permafrost. Although the majority of the trail areas are on soils that are sensitive but more durable than others of the TUA, (see 7MS2 soils in Table 3.1), certain sections are currently problem areas in perhaps any of the four soil types, but these problem areas would be corrected by implementing the management prescriptions in Appendix 5.

Continued subsistence ORV use of the NPS-managed trails would likely concentrate many of the impacts to those trails; however, as just described, the four existing trails are among those with the least existing soils impacts. These trails would be made even more durable as a result of construction improvements made as prescribed for this alternative. This action, coupled with trail condition monitoring and management (with well-defined and established threshold limits, and well defined and measured impact parameters), closure options, and limitations on the type and weights of ORVs, would greatly minimize overall soil impacts on the retained trails.

Under this alternative, closures would reduce soil impacts from 36.5 acres to 5.8 acres. It is unknown how long natural recovery of soils would take in these areas, but regaining the complete soil profile would probably require several hundreds of years.

The primary mechanisms of soils impact in the TUA are from ORV wheel contact (abrasion, shearing, compression, displacement), damages to soils from impact (compaction; mixing; burying; and abrading), and secondary effects from the effects on impacted soils (erosion, deposition of eroded material, ponding).

Initially, under Alternative 2, four-wheel drive/track-equipped ORVs and those ORVs designed with Best Available Technology would be managed the same way and would not be allowed on slopes greater than 20% or across saturated soils such as found in open wetlands, low shrub/open wetland mixes, willow swamps, and streams and ravine corridor. This would mean 23,091 acres of the TUA would be closed to ORV use initially. Due to the elimination of ORV travel on wet and other sensitive soils, it is likely that the direct and indirect off-trail impacts to soils would be more dispersed and of low to medium intensity. However, using a range of between one-half mile-to-three miles for a one-way retrieval trip, it is estimated that between 51 to 959 acres of new off-trail impacts to soils would occur over 15 years, depending on the types of landscapes driven through (see Section 4.4.4 for additional assumptions supporting these estimates).

Under this alternative, a new ORV trail would be constructed to access the Bull River Floodplain. Construction of the Bull River Access Trail, assuming 1.7 miles of length, and up to an 8 foot average width of disturbance (to achieve a 6 foot drivable surface), would involve 1.7 acre of surface area, thus, 1.7 acres of soil loss. However, it is expected that the new trail would be designed so that adverse soils impacts from trail use (such as erosion) would not occur.

At most, construction of trails in the Upper Cantwell Creek and Bull River Floodplains would total approximately 2 miles and would affect about 2 acres of soils through trail hardening and use. Trail delineation and maintenance would produce soil impacts from brush clearing, surface blading, gravel capping, or other forms of hardening, cutting ramps on or off elevated bars, and creating cross drainage. The Bull River and Cantwell Creek open gravel floodplains would be available for subsistence ORV use under this alternative (approximately 250 acres), along flexible routes that would depend upon the day-to-day movements of the braided stream channels. Floodplain routes would be on gravel bars where compaction might be the most detectable impact, and track impressions should be erased annually by the day-to-day changes of the braided glacial river.

Some foot travel for subsistence use can be expected for a small number of trails. Some further amount of soils damage could be realized by the method(s) chosen for retrieval of harvested game including use of horses. Horses can churn the soil strata, especially in sensitive soils. However, horse traffic is expected only during the hunting season, in limited numbers, and the use would create narrower travel corridors, resembling natural use from moose and caribou.

Cumulative Impacts

Present and future conditions as outlined in the “Cumulative Impacts Associated with Alternative 1 are also applicable here. The expected population growth, coupled with tourism growth could increase direct and indirect impacts to the TUA trails and overland areas.

Overall, Alternative 2 would result in moderate additional adverse impacts. The cumulative impact of Alternative 2 on soil resources coupled with any past, present, and future actions would likely be moderate.

Conclusion

Actions in this alternative would have a moderate impact on soils in the Cantwell TUA because of widespread long-term ORV use in many areas of the TUA. An estimated 51 to 959 acres of new off-trail impacts to soils would occur over 15 years, depending on the types of landscapes driven through. Impacts would include churning and rutting, as well as erosion. In addition to these impacts, soils would be directly affected by construction on 1.7 acres for the new Bull River Access Trail, another 2.0 acres to maintain trails through the Bull River and Upper Cantwell Creek Floodplains, and by continued use on 5.8 acres of the four trails retained. NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts. As a result, overall soils impacts under this alternative are expected to be moderate.

The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.3.5 Impacts of Alternative 3

Under Alternative 3, subsistence ORV use would continue on four existing trails, the newly constructed Bull River Access Trail, and the Bull River and Upper Cantwell Creek Floodplains. All other trails would be closed for recovery (same as Alternative 2). No off-trail ORV use would be permitted. The NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence hunt by snowmachine, primarily in the area southwest of Cantwell Creek and into the Bull River area.

Like Alternative 2, continued subsistence ORV use on four NPS-managed trails would concentrate the impacts to those areas (a 5.8 acre footprint), especially given that the rest of the TUA would be closed to ORV use. Therefore, trail use impacts could increase by the additional concentrated use. However, also as described for Alternative 2, these four trail areas are among those with the least existing soils impacts, and, furthermore, these trails would be made even more durable as a result of construction improvements made as prescribed for this alternative. This action, coupled with trail condition monitoring and management, well-defined and established threshold limits, and well defined and measured impact parameters, and limitations on the type and weights of ORVs, would greatly minimize soils impacts.

At most, construction of trails in the Upper Cantwell Creek and Bull River Floodplains would total approximately 2 miles and would affect about 2 acres of soils through trail hardening and use. Trail delineation and maintenance would produce soil impacts from brush clearing, surface blading, gravel capping, or other forms of hardening, cutting ramps on or off elevated bars, and creating cross drainage. The Bull River and Cantwell Creek open gravel floodplains would be available for subsistence ORV use under this alternative (approximately 250 acres), along flexible routes that would depend upon the day-to-day movements of the braided stream channels. Floodplain routes would be on gravel bars where compaction might be the most detectable impact, and track impressions should be erased annually by the day-to-day changes of the braided glacial river.

Off trail use in Alternative 3 would not be allowed. As a result, the total soil condition of the TUA would improve as vegetative communities and the underlying soils previously impacted

would be allowed to naturally recover. It is unknown how long natural recovery of soils would take in these areas, but regaining the complete soil profile would probably require several hundreds of years.

Some foot travel for subsistence use can be expected for a small number of trails. Some further amount of soils damage could be realized by the method(s) chosen for retrieval of harvested game including use of horses. Horses can churn the soil strata, especially in sensitive soils. However, horse traffic is expected only during the hunting season, in limited numbers, and the use would create narrower travel corridors, resembling natural use from moose and caribou.

The winter hunt (snowmachine use) anticipated by this alternative could indirectly and subtly affect the soils by snow compaction, and subsequent altering the spring melt or on-site water regime. Sensitive soils, such as those of the TUA are quickly altered by nearly any changes in the natural environment, although the impacts would be minor from the amount of snowmachine use likely to occur.

Cumulative Impacts

Present and future conditions as outlined in the Alternative 1 Cumulative Impacts section are also applicable here. In quick review, the expected population growth, coupled with tourism growth could increase direct and indirect impacts to the TUA trails and overland areas.

Overall, Alternative 3 would result in moderate additional adverse impacts. The cumulative impact of Alternative 3 on soil resources coupled with any past, present, and future actions would likely be moderate.

Conclusion

Actions in this alternative would have a moderate impact on soils in the Cantwell TUA because soils would be directly affected by construction on 1.7 acres for the new Bull River Access Trail, another 2.0 acres to maintain trails through the Bull River and Upper Cantwell Creek Floodplains, and by continued use on 5.8 acres of the four trails retained. NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts.

The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.3.6 Impacts of Alternative 4

Under Alternative 4 the Bull River Access Trail would not be constructed and ORV use would not be allowed on the Bull River Floodplain or on the Upper Cantwell Creek Floodplain. The four trails retained for use in Alternatives 2 and 3 would be available in this alternative, but ORV use for subsistence purposes would be authorized only from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons.

This alternative would effectively close all other trails and all areas of the TUA to ORV use. The NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Subsistence Advisory Council to implement a winter subsistence

hunt by snowmachine in the TUA. Additionally, alternative methods to retrieve harvested game would continue to be used, and may increase, such as horsepacking.

There would be a reduced impact on soils resources within the TUA by permitting ORV use only on 5.8 acres of the four retained trails. Shorter term ORV use (hunting season only) of the four authorized trails would further reduce the impacts to soils by limiting the use of the vehicular trails to the time of year when they are likely to be more durable. Coupled with NPS condition monitoring and management control, these impacts should be minimal.

Some foot travel for subsistence use can be expected for a small number of trails. Some further amount of soils damage could be realized by the method(s) chosen for alternative retrieval of harvested game including use of horses. Horses can churn the soil strata, especially in sensitive soils. However, horse traffic is expected only during the hunting season, in limited numbers, and the use would create narrower travel corridors, resembling natural use from moose and caribou.

The closure of all trails and off-trail areas would improve the total soil condition of the TUA because the vegetative communities and the underlying soils would be allowed to naturally recover. It is unknown how long natural recovery of soils would take in these areas, but regaining the complete soil profile would probably require several hundreds of years.

The winter hunt (snow machine use) anticipated by this alternative could indirectly and subtly affect the soils by snow compaction, and subsequent altering the spring melt or on-site water regime. Sensitive soils, such as those of the TUA are quickly altered by nearly any changes in the natural environment, although the impacts would be minor from the amount of snowmachine use likely to occur.

Cumulative Impacts

Present and future conditions as outlined in the Alternative 1 Cumulative Impacts section are also applicable here. The expected population growth, coupled with tourism growth could increase direct and indirect impacts to the TUA trails and overland areas.

Overall, Alternative 4 would result in minor additional adverse impacts. The cumulative impact of Alternative 4 on soil resources coupled with any past, present, and future actions would likely be moderate.

Conclusion

Actions in this alternative would have a minor impact on soils in the Cantwell TUA. Soils would be directly affected by continued use of ORVs on 5.8 acres of the four trails retained. NPS management of trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, especially the indirect impacts.

The level of impacts to soils anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified.

4.4 EFFECTS ON VEGETATION (INCLUDING WETLANDS)

4.4.1 Vegetation Impact Methodology

ORV impacts to vegetation occur based on many factors including weather, microtopgraphy, driver attitude, and ORV use levels and patterns (see Sinnott 1990). To predict impacts with precision, data for existing impacts to trails would ideally be observed over numerous seasons and specifically correlated with use levels. Because this level of data is lacking for the TUA, the predictions below are based on the assumption that impacts documented in 2005 represent previous ORV use levels, and that similar impacts would result from similar use patterns in the future. From the 2005 inventory it is easier to tell susceptibility of a vegetation landscape type to damage than it is to determine how long those impacts would persist or when they were created.

Based on observations of the age and persistence of existing negative impacts in the TUA and elsewhere in Alaska (Liebermann & Roland 2006, Sinnott 1990, NPS 1990), the following are assumptions about minimum-time estimates for the duration of impacts on particular types of vegetation (see Section 4.4.2 for additional discussion on duration of impacts):

- If a trail's path is used for one or very few vehicle passes, negative vegetation and soil impacts could last as little as a year on some dry meadows and subalpine low shrub areas of the TUA.
- Herbaceous vegetation damage could last 1-5 years on a few- or single-pass path on moist but non-saturated soils, for example some wetland edge meadows.
- Negative impacts to vegetation could last much longer on some areas - 3-10 years on willow shrublands, 5-15 years on dwarf birch shrublands, or longer on the saturated soils of open peatlands where revegetation is very slow.
- In the area of heavy soil rutting in the Cantwell Creek West areas, it is possible that partial vegetation recovery would occur in 2-5 years, and partial soil recovery in 5-10 years.
- Wheel ruts from one to a few passes in saturated soils may last from 3-10 years; this can vary based on the depth and width of ruts and soil conditions at damage time and in subsequent seasons (see NPS 1990).
- Vegetation on some shallow or short eroded slopes could possibly recover in 5-10 years if use stopped, but longer or steeper areas would be unlikely to recover soils and vegetation without remediation because of ongoing erosion even if vehicle use ceased.

Another assumption used for analysis is that ORV use within the TUA would increase above present levels. In 2000, about 50% of the nearly 100 subsistence-eligible households in Cantwell attempted to harvest moose, with about 25% successful. It's assumed that at least 50 subsistence-eligible households would continue to engage in subsistence moose hunting. Further, they would hunt in the TUA first before going to other lands outside the TUA, because the 2005 NPS determination that ORVs are a traditional means of access for subsistence purposes within the TUA eliminated the uncertainty about ORV use for subsistence in the TUA. Additionally, the TUA is closer to Cantwell than other hunting lands and hunting there is unaffected by competition with non-local hunters (unlike on lands outside the TUA).

4.4.2 General Vegetation Impacts

Nature and Patterns of Vegetation Impacts

Impact-Causing Agents

ORVs are the main vehicle type used in the TUA for subsistence activities at present, and are the main agent of adverse impacts to vegetation. ORV use can damage both directly and indirectly vegetation by several mechanisms. The primary mechanisms of vegetation impact in the TUA are from direct ORV wheel contact (abrasion, shearing, compression, displacement), vehicle body contact (collision), damages to soils from impact (compaction; mixing; burying; and abrading). There are also indirect effects on vegetation that occur through changes to plant habitat (erosion, deposition of eroded material, ponding). A summary of the agents, nature, and extent of ORV negative impacts is given in Section 3.3.6 of this document and in Liebermann & Roland 2006 (the 2005 survey of ORV impacts in the TU), and Sinnott (1990) and Meyer (2002) for Alaska in general.

Direct vegetation impacts result from abrasion, crushing, or breakage of plant tissues through contact with the vehicle (e.g. tires or tracks). In addition, spinning or skidding of vehicle tires or tracks may cause soil shearing, mixing of soil or indeed patial burying of plants (Meyer 2002, Sinnott 1990). Damages from ORVs may include removal of vegetation, death of plant tissues or entire individuals, and alteration of the habitat for plant growth. Long-term impacts can result from alteration of the habitat through soil damage, erosion, or other secondary impacts. All of these vegetation impacts were documented in the TUA in 2005 (Liebermann and Roland, 2006). Each of these can have negative consequences for vegetation, ranging from mechanical damage, reduced productivity, changes in species composition, or long term changes in the appearance of the vegetation, to complete destruction or removal of the vegetation of an area.

In general, light amounts of ORV traffic may cause damage to vegetation, although the severity of damage usually increases on a given vegetation type with the number of passes. This increase is not necessarily linear, and the majority of negative impacts often occur in the first few passes of ORVs (NPS 1990; Sinnott 1990; Sparrow, Wooding & Whiting 1976; also see NPS 2005c for a review of ORV impacts in Alaska). Within the TUA, many areas with even a single pass had unacceptable vegetation and/or soil damages that would persist for many years, such as on the branching trails from the Windy Creek Bowl trail and areas of the Cantwell Creek West-Center area (Liebermann & Roland 2006).

Differential Response of Landscape Types to Impacts

The level of impact and vegetation response varies among ecosystems and is, based on the relative resilience of soils and vegetation. The resilience of the vegetation depends on the relative abundance of different plant growth forms, local soil qualities, and intensity and type of ORV use (NPS 1998, Wooding & Sparrow 1978, Sinnott 1990). Different vegetation types sustain and recover from damages at different rates and thus the amount of damage is difficult to predict with precision.

Fatal damages to plants are sustained more rapidly by herbaceous plants because their tissue is generally less structurally resilient compared to woody shrubs. Woody plants, on the other hand, are normally slower to recover fully because of their generally slower growth rates. Mesic graminoid meadows would recover more quickly and completely than saturated sedge meadow because of more productive soils and faster growing vegetation in the dry meadows.

In general, wetter, more open areas are more sensitive to **vegetation and soil disruption** from ORV travel, and drier areas are less so. This is because saturated soils have less structural resilience and the herbaceous wetland vegetation is more easily damaged both above and below the ground surface. Some saturated areas (such as willow swamps) may be able to initially withstand some wheel abrasion before forming deep ruts or similar soil-related damages because of the additional resistance provided by the woody roots, though repeated abrasion would eventually degrade the roots as negative impacts proceed. Areas with fewer woody plant roots in the soil (such as swales on the floodplain or wet meadows) have a greater susceptibility to soil disruptions that can permanently damage the vegetation after low numbers of passes; after several passes durability of the few roots is lost and the organic mat is easily damaged.

Shrub **breakage and removal** is often the most visible type of vegetation impacts resulting from ORV use, readily marking an area as an obviously ORV trail. This can cause single-pass routes to be reused when an operator is seeking a proven path to follow with the fewest obstructions (Wooding & Sparrow 1978, Sinnott 1990,). After several vehicle passes most shrub growth is killed or redirected from the wheel contact areas a trail path, creating a semi-permanent path (NPS 1990). Willow and dwarf birch shrublands show markedly differential responses and rates of recovery from disturbance. While willow may show more mechanical damage immediately following a single vehicle pass, they also recover more quickly from damage because of their faster growth rates. After several passes in wet terrain, however, if the root system and organic mat are severly damaged, negative impacts may be more long-lasting. Dwarf birch damages may not be as highly visible following a single pass due to its more prostrate form and thinner branch growth, but it apparently sustains damages to leaf buds and shoots more readily (NPS 1990, Sinnott 1990, ADFG 1996b) and recovers from mechanical damage more slowly than willow (Liebermann and Roland, 2006). Damage from a single pass has been found to be obvious in a dwarf birch shrubland years after the initial disturbance (NPS 1990, Wooding & Sparrow 1978, (Liebermann and Roland, 2006). Dwarf birch is a late-success ional species and grows more slowly, on average, than does willow.

When vegetation is removed from wheel tracks, recovery can take considerably longer than if the plants were damaged but not removed. Additionally, different species (native or invasive) from the original native vegetation may occupy the newly exposed soil. If soils are damaged or removed, vegetation recovery may not occur for a very long time. Another form of vegetation "removal" occurs when wheel ruts bury and mix surface vegetation, though this is usually difficult to separate from non-mixing vegetation removal in field surveys.

Negative impacts to the vegetation-soil interface are much more severe when the organic mat is perforated. With the organic mat intact, roots and soils are protected and provide resistance to erosion and soil loss and give a bed for plant revegetation. If the organic mat is torn or perforated, erosion is much more likely and revegetation is much slower. Organic mat perforation is most common at present in areas of saturated soils and deep wheel ruts, on steep slopes that have undergone some erosion, and on heavily used trails.

Vegetation community composition change may occur when the plant habitat has been altered to the degree that recovery or regeneration of the existing plant community is hindered.

4.4.3 Impacts to Vegetation under Alternative 1 (No Action)

Under Alternative 1, the Cantwell TUA would remain open to the use of any type of ORVs by NPS qualified subsistence users for any type of subsistence purpose. However, it’s assumed that

ORV use would continue to be concentrated along Cantwell Creek, Cantwell Airstrip Trail, and the Windy Creek trails during the moose and caribou hunting season in August and September.

On-Trail/Route Impacts

Negative impacts ranging from lightly visible travel passes to intense degradation would continue to occur on a total of 36.5 acres stretching over 22.8 miles of existing trail and area impacts (see Section 3.3.6). However, since ORV trails and routes tend to increase in length and expand at areas of obstructions or degradation (Sinnott 1990), an increase in ORV use impact area and intensity on existing trails and routes would be likely.

Impacts would be most severe on the most heavily used Windy Creek North, Cantwell Northwest, Cantwell Airstrip, and Cantwell Creek West trails. Because much of the travel to these areas would likely occur during the short hunting season, degradation such as mudholes and rutting may increase much more rapidly than if use levels were evenly distributed over more of the year, which would allow some partial recovery between vehicle passes (Sinnott 1990). This would result in increasing segments of existing trails becoming braided or impassible and the consequent creation of detour trails or braids around severely degraded areas, further increasing the "footprint" of the impacted area.

Existing trail and area impacts would not be expected to recover significantly in any areas that continue to be used for ORV travel and thus would be classified as "persistent" impacts.

Off-Trail/Route Impacts

Since there would be no restriction on types of ORVs or where and when they could be driven within the TUA, ORV users would likely pioneer new vehicle passes into previously non-impacted vegetation. These newly pioneered passes may be disproportionately on open or semi-open areas because of the ease of travel. Other users subsequently could use these paths because of the visible vegetation clearing, creating new frequently used trails. Many older trails that were mapped in 2005 appear to have started as single-use passes under similar circumstances.

Trails would create linear areas of damage, with obvious shrub breakage and scraping, herbaceous vegetation stripping, erosion, organic mat removal, soil compaction, and, especially in wet areas, soil mixing and rutting. Many of these types of damage could lead to alteration of habitat for plant growth and thus eventually to changes in plant community composition.

In addition to trail-related impacts, ORV travel on lightly or non-vegetated floodplain gravel bars could prevent or alter natural vegetation succession on newly abandoned surfaces by damaging, moving, or removing new vegetation or soils. (Note that similar impacts could occur naturally due to flooding.)

It is difficult to predict recovery times for heavily impacted areas based on existing information. Most adversely impacted areas probably would take 1 to 15 years or more to recover to the *appearance* of non-traveled areas, and longer to recover to the point at which impacts were beyond detection. Actual recovery times would depend on the vegetation type, amount of soil impact, and ORV use intensity (see Section 4.4.1). Thus, the entire area of new trail formation could increase for many years until trail creation is balanced with the recovery of non-used trails. In practice this point may not be reached if increasing travel distances on the expanded trail network or number of ORV users outbalances abandonment of trails.

Given that that ORV use in the TUA would increase, negative impacts to previously non-impacted lands could be widespread and common. Over the long term, vegetation could be adversely impacted throughout the 32,159 acre TUA. However, most impacts probably would occur on the 2,900 acres of flat (i.e., less than 20% slope) and open terrain composed of open wetlands, low shrub-open wetland mix, tussock meadows, open gravel floodplains, lightly vegetated gravel bar, open water (water greater than one inch deep), and upland and alpine meadows. This expectation is supported by available evidence of past ORV use in the TUA, which indicates that ORV users prefer wetlands and wetland margins for travel, because visibility for hunting is greater and there are fewer impediments to travel like shrubs and trees (Liebermann and Roland 2006).

Wetlands Impacts

As discussed in Section 3.3.6, approximately 13.5 linear miles and 22 acres of the existing trail and area impacts documented in the TUA are on wetlands. Impacts to these wetlands from ORV use would continue under this alternative.

Because use is permitted on wetlands under this alternative, ORV travel is likely to expand into approximately 2,292 acres of currently non-impacted open wetlands, low shrub-open wetland mix, and open water wetland types that are found below 20% slope. Negative impacts such as vegetation removal, rutting, trail braiding and creation of parallel paths, and water channel modification would be very likely. Within the floodplains, for example, ORVs would likely be driven off the floodplain across willow and open wetland areas in order to avoid having to cross deep flowing water. Frequent crossing from one bank to the other because of steep cutbanks would also likely occur. As a result of these conditions, much "route searching" via trial and error would be necessary to find a usable path. This would cause adverse impacts to sensitive floodplain wetland habitats.

Impacts to Rare Plants

Botrychium alaskense, a rare fern, occurs in river flats in this area of Denali NPP and is at the northern limit of its known range in the area. It would be expected to be found in the TUA, particularly on the Cantwell Creek and Bull River Floodplain. Unrestricted travel on the floodplain could disrupt this plant if it is present.

Invasive Plants Introduction

Another impact which is possible, but which has not yet been detected in the TUA, is invasive species colonization of ORV-disturbed areas. ORVs can transport exotic seeds or create areas of open soil and damaging less aggressive native vegetation. The most imminent threat is that of *Melilotus alba*, white sweet clover. It has invaded floodplains in central Alaska, including the Nenana River and some areas of Denali NP, and has apparently been seeded along the Parks Highway (Densmore et al. 2001). Invasion of forest clearings or meadows is also possible by this species. Almost all ORV's enter the TUA via the Parks Highway corridor where *M. alba* is established increasing the likelihood of invasion.

Vegetation Restoration

Under this alternative, the NPS would not close any areas for recovery; therefore, the existing impacts on vegetation, including wetlands, would remain as described above.

Impacts from Winter Hunt

The NPS would not seek to implement a winter subsistence moose hunt under this alternative; therefore, there would be no associated impacts.

Cumulative Impacts

Population growth of the area is likely to increase. Park visitation is also likely to increase over the next 20 years. Visitor use activities in this part of the park would likely include summer hiking and horseback riding. Winter activities such as dog mushing and snow machining would also likely increase. The summer activities can provide direct impacts to vegetation and wetlands resources while other activities (snow machining, and mushing) can directly affect the vegetation by damage to exposed branches, by damage to under-snow branches through compression and by subsequent alteration of the spring melt or on-site water regime. Population growth, coupled with tourism growth would increase direct and indirect impacts to the TUA trails and overland areas.

The above past, present, and reasonably foreseeable future actions would have a moderate adverse impact on vegetation. The implementation of Alternative 1 would result in additional major adverse impacts on vegetation and wetland resources; therefore, the total cumulative adverse impact on vegetation and wetland resources would be major.

Conclusion

Alternative 1 would have a major adverse impact on vegetation and wetlands because of widespread, intense, long-term ORV use in many areas of the TUA. Given that that ORV use in the TUA would increase, negative impacts to previously non-impacted lands could be widespread and common. Over the long term vegetation could be adversely impacted throughout the 32,159 acre TUA. However, most impacts probably would occur on the 2,900 acres of flat and open terrain composed of open wetlands, low shrub-open wetland mix, tussock meadows, open gravel floodplains, lightly vegetated gravel bar, open water, and upland and alpine meadows. This 2,900 acres of impact includes approximately 2,314 acres of wetland impacts.

The level of impacts to vegetation and wetlands anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park, including the preservation of lands and waters for present and future generations, preservation of scenic values, the maintenance of sound habitat for wildlife, and the preservation of extensive unaltered ecosystems in their natural state.

4.4.4 Impacts to Vegetation under Alternative 2

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on the following NPS-managed trails and routes: the existing Windy Creek Access, Windy Creek Bowl, Cantwell Airstrip, and Pyramid Peak Trails; the Bull River Access Trail (new construction); and on the Upper Cantwell Creek and Bull River Floodplain Trails/Routes. The 17b easement through Ahtna Inc. property in the Windy Creek area would continue to be managed as it has in the past but would be improved to mitigate impacts.

On-Trail/Route Impacts

Alternative 2 would have the following impacts associated with ORV trails and the 17b easement:

- Implementing the closures would reduce existing trail and area impacts from 36.5 acres to 5.8 acres within primarily dwarf birch shrublands and spruce-willow/alder woodlands.
- Construction of the new Bull River Access Trail would result in removal of about 1.7 acres of vegetation, over half of which would be dwarf birch shrublands vegetation and the rest willow floodplain type wetlands.
- At most, construction of trails in the Upper Cantwell Creek and Bull River Floodplains would remove about 2.0 acres of primarily successional herbaceous and willow shrub floodplain vegetation.
- Improving the 17b easement would ensure vegetation impacts are restricted to a 1.7 mile by 6 foot wide corridor, or approximately 1.2 acres.

On improved trails, the new modifications would likely confine traffic mainly to the single path and sustain increased travel with less degradation than at present. Concentrating traffic to a few trails and the floodplain routes would also increase the amount of near-trail visible negative impacts such as from ORV vehicle pullouts. As this is most likely in and near wetland areas because of hunting habitat, these impacts would be more common on those areas. This impact to vegetation from ORV users pulling off the trail would be minimal.

Fill material for trail construction would come from either the trail alignment itself or from the nearby unvegetated gravel floodplain; therefore, obtaining the fill material would not create additional impacts to vegetation.

In addition to the trails, approximately 250 acres of open gravel bar and water channels (out of a total of 473 acres of floodplains within the TUA), would be available for flexible route-finding by ORV users on the Upper Cantwell Creek and the Bull River Floodplains. ORV travel on lightly or non-vegetated floodplain gravel bars could retard or alter natural vegetation succession on newly abandoned surfaces by damaging, moving, or removing new vegetation or soils. (Note that similar impacts could occur naturally due to flooding.) Invasion of non-native species as discussed below also is particularly likely on these areas. Access to and from the floodplain via floodplain slopes would result in erosion, vegetation stripping, and other damage to these slopes.

Delineating trails and routes in the Upper Cantwell Creek and Bull River Floodplains would eliminate the need for ORV users to "route search" via trial and error, thus, eliminating related adverse impacts to wetlands and other types of vegetation (see on-trail/route impacts described under Alternative 1).

Off-Trail/Route Impacts

Under this alternative, approximately 9,068 acres of non-wetland dominated vegetation would be open to off-trail ORV use for the purpose of retrieving harvested moose or caribou. However, impacts would be limited to the actual paths taken by ORVs for retrieval of the harvested animals. To estimate these impacts, the following assumptions were made:

- 8 moose and 4 caribou would be harvested annually in the TUA by subsistence hunters;
- 4 one-way ORV passes would be needed to retrieve a moose;
- 2 one-way passes would be needed to retrieve a caribou; and
- One-way retrieval trips would range from ½ mile to 3 miles distance.

Given the above assumptions, and the estimated duration of impacts on particular vegetation types (Section 4.4.1), retrieval of moose and caribou could create 51 to 959 acres of new off-trail

vegetation impacts over 15 years. The 51 to 959 acres of impact created would not be concentrated in one area, but would form of a "web" of vegetation impacts apparent from air and ground to other users of the TUA. Because of better visibility, more animals likely would be taken in low vegetation such as the wetland openings than in closed scrub vegetation. Therefore, the web of retrieval trails would be distributed primarily around these wetland areas.

To mitigate impacts, the NPS would require off-trail ORV users to abide by best management practices and also would implement degradation levels to identify and take management actions to reduce the potential for ORV impacts in the TUA (see Section 2.3.6). Regardless of these measures, however, the magnitude of impacts would range from low intensity damage such as stem breakage, to high intensity damage such as removal of the organic mat, heavy soil compaction, or other impacts that alter habitat for plant growth or change plant community composition. The 51 acre estimate represents a scenario with primarily low intensity impacts resulting from short retrieval routes (½ mile one-way) that cross vegetation types that for the most part recover from ORV impacts within 2 to 5 years (e.g., wetland edge meadows). On the other hand, the 959 acre estimate represents a scenario with primarily high intensity impacts resulting from long retrieval routes (3 miles one-way) that cross vegetation types that for the most part recover from ORV impacts within 6 to 15 years (e.g., willow and dwarf birch shrublands).

Wetland Impacts

Alternative 2 would result in the following wetland impacts related to trail construction:

- About 0.4 acres of wetlands within spruce-willow/alder woodlands and willow or alder shrublands would be adversely impacted by continued ORV travel on the Cantwell Airstrip and the Pyramid Peak Trails.
- Approximately 0.1 acre of wetland would be impacted by construction of the Bull River Access Trail, including wet willow shrublands and steep-sided ravines.
- At most, about 1 acre of willow floodplain type wetlands would be impacted by ORV trail construction in the Upper Cantwell Creek and the Bull River Floodplains.

Under this alternative, about 2,514 acres of open wetlands, willow swamps, low shrub/open wetland mixes, and streams and ravine corridors in the TUA would be closed to ORV use because they have saturated soils that are easily damaged by ORVs. This would include 21.6 acres of existing wetland impacts.

As described under “Off-Trail/Route Impacts,” retrieval of moose and caribou could create 51 to 959 acres of new off-trail vegetation impacts over 15 years. Within this total, between 10 and 130 acres of scattered wetlands off-trail could be adversely impacted because several common vegetation types that would be open to off-trail ORV use have at least a 25% wetland component (i.e., river floodplain slopes, willow or alder shrublands, spruce-willow/alder woodlands, and willow floodplain) that could not be effectively separated out given the information available and the mapping scale used.

Although the NPS would close most saturated soils and wetlands to all ORV use under this alternative, in practice, it is difficult or impossible for an ORV operator to avoid driving across these areas when traveling off-trail. The area between Upper Cantwell Creek and Bull River is composed of a mosaic of wetlands and more durable vegetation. Within in this area, in order to retrieve harvested moose and/or caribou by ORV and abide by the closures, saturated soils and wetland areas would have to be skirted – a difficult task given the intricate nature of the mosaic. Even were ORV operators physically able to avoid the closed areas, it is unlikely the average

ORV operator could always reliably differentiate between the vegetation types that are open versus closed. As a result, many ORV operators would inadvertently drive across closed areas, with distances crossed ranging from several meters to several hundred meters. Given these conditions, the closures, which theoretically would reduce impacts to saturated soils and wetlands, would probably not meet that goal in reality.

Impacts to Rare Plants

There could be negative impacts to rare species on the floodplains; this is discussed under Alternative 1.

Invasive Plants Introduction

Improving the trails by adding soil, gravel, or vegetation from off-site could introduce alien plant species to the area, as has been a frequent problem in other areas of the Park. However, areas affected by construction would be revegetated with native species to minimize this possibility.

The introduction of invasive plants, particularly *Melilotus alba*, is possible, as discussed under Alternative 1. The construction of a new trail to the Bull River Floodplain would likely increase ORV use to that floodplain and increase the chance of this plant being introduced or facilitated there. *M. alba*, if introduced to the floodplain, would likely spread rapidly, displacing native species, and would be particularly likely to spread to floodplain areas where ORV-related soil and vegetation disruption has been sustained.

Vegetation Restoration

Under Alternative 2, the most severely impacted trails and area surveyed in the TUA would be closed to ORV use and recovery of vegetation could begin. No active restoration activities would occur, except on the Windy Creel Ravine trail and the closed section of the Windy Creek Bowl trail which would undergo active remediation.

Since most of the damage in the closure area is on open wetlands and involves deep soil ruts and mixing and organic mat damage, many impacted areas would likely require 10 years or longer to fully recover. Vegetation recovery may be somewhat faster; perhaps 4-7 years for open wetland areas where rutting and mudholes were not as severe. One ongoing problem would be ensuring that previously damaged vegetation is properly safeguarded so that the process of restoration is not reset before it is completed.

In terms of closures due to new impacts, there would likely be a time lag between identification of severe negative impacts observed in monitoring and the implementation of closures, with negative impacts potentially intensifying or expanding before restrictions are made.

Impacts from Winter Hunt

The NPS would not seek to implement a winter subsistence moose hunt under this alternative; therefore, there would be no associated impacts.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions and their impacts are described under Alternative 1 (No Action-Alternative). Cumulatively, these actions have had a moderate adverse

impact on vegetation. The implementation of Alternative 2 would result in additional major adverse impacts on vegetation and wetland resources; therefore, the total cumulative adverse impact on vegetation and wetland resources would be major.

Conclusion

Under Alternative 2, adverse impacts on vegetation and wetlands would be major. Trail construction, improvement, and maintenance would adversely impact a total of 10.7 acres of primarily dwarf birch shrublands, spruce-willow/alder woodlands, willow floodplain type wetlands, successional herbaceous vegetation, and willow shrub floodplain vegetation. This total includes about 1.5 acres of wetlands. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes.

Off-trail ORV use for retrieval of harvested moose and caribou could impact from 51 acres to 959 acres. The 51 acre estimate represents a scenario with primarily low intensity impacts resulting from short retrieval routes (½ mile one-way) that cross vegetation types that for the most part recover from ORV impacts within 2 to 5 years (e.g., wetland edge meadows). On the other hand, the 959 acre estimate represents a scenario with primarily high intensity impacts resulting from long retrieval routes (3 miles one-way) that cross vegetation types that for the most part recover from ORV impacts within 6 to 15 years (e.g., willow and dwarf birch shrublands). Included within this off-trail range would be between 10 and 130 acres of adverse impacts to wetland vegetation (i.e., scattered wetlands within units of floodplain slopes, willow or alder shrublands, spruce-willow/alder woodlands, willow floodplain, and lightly vegetated gravel bars).

Were the upper level of impacts to be reached, this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park, including the preservation of lands and waters for present and future generations, preservation of scenic values, the maintenance of sound habitat for wildlife, and the preservation of extensive unaltered ecosystems in their natural state.

4.4.5 Impacts to Vegetation under Alternative 3

Under Alternative 3, ORV use for all subsistence purposes would continue to be allowed only on the following NPS-managed trails and routes: the existing Windy Creek Access, Windy Creek Bowl, Cantwell Airstrip, and Pyramid Peak Trails; the Bull River Access Trail (new construction); and on the Upper Cantwell Creek and Bull River Floodplain Trails/Routes. The 17b easement through Ahtna Inc. property in the Windy Creek area would continue to be managed as it has in the past but would be improved to mitigate impacts. The NPS also would work to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area.

On-Trail/Route Impacts

Like Alternative 2, Alternative 3 would have the following impacts associated with ORV trails and the 17b easement:

- Implementing the closures would reduce existing trail and area impacts from 36.5 acres to 5.8 acres within primarily dwarf birch shrublands and spruce-willow/alder woodlands.

- Construction of the new Bull River Access Trail would result in removal of about 1.7 acres of vegetation, over half of which would be dwarf birch shrublands vegetation and the rest willow floodplain type wetlands.
- At most, construction of trails in the Upper Cantwell Creek and Bull River Floodplains would remove about 2.0 acres of primarily successional herbaceous and willow shrub floodplain vegetation.
- Improving the 17b easement would ensure vegetation impacts are restricted to a 1.7 mile by 6 foot wide corridor, or approximately 1.2 acres.

On improved trails, the new modifications would likely confine traffic mainly to the single path and sustain increased travel with less degradation than at present. Concentrating traffic to a few trails and the floodplain routes would also increase the amount of near-trail visible negative impacts such as from ORV vehicle pullouts. As this is most likely in and near wetland areas because of hunting habitat, these impacts would be more common on those areas. This impact to vegetation from ORV users pulling off the trail would be minimal.

Fill material for trail construction would come from either the trail alignment itself or from the nearby unvegetated gravel floodplain; therefore, obtaining the fill material would not create additional impacts to vegetation.

In addition to the trails, approximately 250 acres of open gravel bar and water channels (out of a total of 473 acres of floodplains within the TUA), would be available for flexible route-finding by ORV users on the Upper Cantwell Creek and the Bull River Floodplains. ORV travel on lightly or non-vegetated floodplain gravel bars could retard or alter natural vegetation succession on newly abandoned surfaces by damaging, moving, or removing new vegetation or soils. (Note that similar impacts could occur naturally due to flooding.) Invasion of non-native species as discussed below also is particularly likely on these areas. Access to and from the floodplain via floodplain slopes would result in erosion, vegetation stripping, and other damage to these slopes.

Delineating trails and routes in the Upper Cantwell Creek and Bull River Floodplains would eliminate the need for ORV users to "route search" via trial and error, thus, eliminating related adverse impacts to wetlands and other types of vegetation (see on-trail/route impacts described under Alternative 1).

Off-Trail/Route Impacts

Under this alternative, there would be no off-trail/route impacts, because no ORVs would be authorized to travel off the NPS-managed trails and routes.

Wetland Impacts

Alternative 3 would result in the following wetland impacts related to trail construction:

- About 0.4 acres of wetlands within spruce-willow/alder woodlands and willow or alder shrublands would be adversely impacted by continued ORV travel on the Cantwell Airstrip and the Pyramid Peak Trails.
- Approximately 0.1 acre of wetland would be impacted by construction of the Bull River Access Trail, including wet willow shrublands and steep-sided ravines.
- At most, about 1 acre of willow floodplain type wetlands would be impacted by ORV trail construction in the Upper Cantwell Creek and the Bull River Floodplains.

Under this alternative, about 2,514 acres of open wetlands, willow swamps, low shrub/open wetland mixes, and streams and ravine corridors in the TUA would be closed to ORV use, as well as another 1,387 acres of wetlands within vegetation types dominated by upland characteristics. This would include 21.6 acres of existing wetland impacts.

Impacts to Rare Plants

There could be negative impacts to rare species on the floodplains; this is discussed under Alternative 1.

Invasive Plants Introduction

Improving the trails by adding soil, gravel, or vegetation from off-site could introduce alien plant species to the area, as has been a frequent problem in other areas of the Park. However, areas affected by construction would be revegetated with native species to minimize this possibility.

The introduction of invasive plants, particularly *Melilotus alba*, is possible, as discussed under Alternative 1. The construction of a new trail to the Bull River Floodplain would likely increase ORV use to that floodplain and increase the chance of this plant being introduced or facilitated there. *M. alba*, if introduced to the floodplain, would likely spread rapidly, displacing native species, and would be particularly likely to spread to floodplain areas where ORV-related soil and vegetation disruption has been sustained.

Vegetation Restoration

Under Alternative 3, the most severely impacted trails and area surveyed in the TUA would be closed to ORV use and recovery of vegetation could begin. No active restoration activities would occur, except on the Windy Creel Ravine trail and the closed section of the Windy Creek Bowl trail which would undergo active remediation.

Since most of the damage in the closure area is on open wetlands and involves deep soil ruts and mixing and organic mat damage, many impacted areas would likely require 10 years or longer to fully recover. Vegetation recovery may be somewhat faster; perhaps 4-7 years for open wetland areas where rutting and mudholes were not as severe. One ongoing problem would be ensuring that previously damaged vegetation is properly safeguarded so that the process of restoration is not reset before it is completed.

In terms of closures due to new impacts, there would likely be a time lag between identification of severe negative impacts observed in monitoring and the implementation of closures, with negative impacts potentially intensifying or expanding before restrictions are made.

Impacts from Winter Hunt

Under Alternative 3, a winter hunt would be implemented in the TUA, primarily in the area between Cantwell Creek and Bull River, though details are not yet complete. If snowmachines were used for this hunt, damage could result, particularly to vegetation not completely covered by snow such as willows, dwarf birch, blueberries, and small spruce trees. Snowmachine use could occur over much of the lower slopes of the TUA and directly affect the vegetation by breaking exposed branches, compressing and damaging undersnow branches, and by subsequently altering the spring melt or on-site water regime. As with all snowmachine use in the park, however, regulations at 43 CFR 36.11 require there be adequate snow cover to protect the underlying

vegetation and soil. This requirement would cushion most of the vegetation from serious damage, though adverse impacts would still be possible in some places because of the wide variety of terrain and climatic conditions and because the determination of adequate snow cover applies to relatively large areas.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions and their impacts are described under Alternative 1 (No Action-Alternative). Cumulatively, these actions have had a moderate adverse impact on vegetation. The implementation of Alternative 3 would result in additional moderate adverse impacts on vegetation and wetland resources; therefore, the total cumulative adverse impact on vegetation and wetland resources would continue to be moderate.

Conclusion

Under Alternative 3, adverse impacts on vegetation and wetlands would be moderate. Trail construction, improvement, and maintenance would adversely impact a total of 10.7 acres of primarily dwarf birch shrublands, spruce-willow/alder woodlands, willow floodplain type wetlands, successional herbaceous vegetation, and willow shrub floodplain vegetation. This total includes about 1.5 acres of wetlands. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes. In addition, approximately 250 acres of open gravel bar and water channels could be impacted by ORV operators traveling along the Upper Cantwell Creek and Bull River Floodplain routes. If snowmobiles were used for a winter subsistence moose hunt, there is the possibility of vegetation damage from their use; however, regulations requiring adequate snow cover would minimize these impacts.

The level of impact under this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.4.6 Impacts to Vegetation under Alternative 4

Under Alternative 4, ORV use for all subsistence purposes would continue to be allowed only on the existing Windy Creek Access, Windy Creek Bowl, Cantwell Airstrip, and Pyramid Peak Trails. The 17b easement through Ahtna Inc. property in the Windy Creek area would continue to be managed as it has in the past but would be improved to mitigate impacts. The NPS would authorize this use only from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons. The NPS also would work to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area.

On-Trail/Route Impacts

Implementing the closures under Alternative 4 would reduce existing trail and area impacts from 36.5 acres to 5.8 acres within primarily dwarf birch shrublands and spruce-willow/alder woodlands. Improving the 17b easement would ensure vegetation impacts are restricted to a 1.7 mile by 6 foot wide corridor, or approximately 1.2 acres.

On the four improved NPS-managed trails, the new modifications would likely confine traffic mainly to the single path and sustain increased travel with less degradation than at present.

Concentrating traffic to a few trails would also increase the amount of near-trail visible negative impacts such as from ORV vehicle pullouts. As this is most likely in and near wetland areas because of hunting habitat, these impacts would be more common on those areas. This impact to vegetation from ORV users pulling off the trail would be minimal.

Off-Trail/Route Impacts

Under this alternative, there would be no off-trail/route impacts, because no ORVs would be authorized to travel off the NPS-managed trails and routes.

Wetland Impacts

Under Alternative 4, about 0.4 acres of wetlands within spruce-willow/alder woodlands and willow or alder shrublands would be adversely impacted by continued ORV travel on the Cantwell Airstrip and the Pyramid Peak Trails.

About 2,514 acres of open wetlands, willow swamps, low shrub/open wetland mixes, and streams and ravine corridors in the TUA would be closed to ORV use, as well as another 1,387 acres of wetlands within vegetation types dominated by upland characteristics. This would include 21.6 acres of existing wetland impacts.

Impacts to Rare Plants

Botrychium alaskense, a rare fern, occurs in river flats in this area of Denali NPP and is at the northern limit of its known range in the area. It would be expected to be found in the TUA, particularly on the Cantwell Creek and Bull River Floodplain. Because there would be no ORV use on these floodplains under this alternative, adverse impacts to this rare plant would not be anticipated.

Invasive Plants Introduction

ORVs can transport exotic seeds or create areas of open soil and damaging less aggressive native vegetation. The most imminent threat is that of *Melilotus alba*, white sweet clover. It has invaded floodplains in central Alaska, including the Nenana River and some areas of Denali NP, and has apparently been seeded along the Parks Highway (Densmore et al. 2001). Invasion of forest clearings or meadows is also possible by this species. Almost all ORV's enter the TUA via the Parks Highway corridor where *M. alba* is established increasing the likelihood of invasion.

Improving the trails by adding soil, gravel, or vegetation from off-site also could introduce species such as *Melilotus alba*. However, areas affected by construction would be revegetated with native species to minimize this possibility.

Vegetation Restoration

Under Alternative 4, the most severely impacted trails and area surveyed in the TUA would be closed to ORV use and recovery of vegetation could begin. No active restoration activities would occur, except on the Windy Creel Ravine trail and the closed section of the Windy Creek Bowl trail which would undergo active remediation.

Since most of the damage in the closure area is on open wetlands and involves deep soil ruts and mixing and organic mat damage, many impacted areas would likely require 10 years or longer to

fully recover. Vegetation recovery may be somewhat faster; perhaps 4-7 years for open wetland areas where rutting and mudholes were not as severe. One ongoing problem would be ensuring that previously damaged vegetation is properly safeguarded so that the process of restoration is not reset before it is completed.

In terms of closures due to new impacts, there would likely be a time lag between identification of severe negative impacts observed in monitoring and the implementation of closures, with negative impacts potentially intensifying or expanding before restrictions are made.

Impacts from Winter Hunt

As under Alternative 3, a winter hunt would be implemented in the TUA, primarily in the area between Cantwell Creek and Bull River, though details are not yet complete. If snowmachines were used for this hunt, damage could result, particularly to vegetation not completely covered by snow such as willows, dwarf birch, blueberries, and small spruce trees. Snowmachine use could occur over much of the lower slopes of the TUA and directly affect the vegetation by breaking exposed branches, compressing and damaging undersnow branches, and by subsequently altering the spring melt or on-site water regime. As with all snowmachine use in the park, however, regulations at 43 CFR 36.11 require there be adequate snow cover to protect the underlying vegetation and soil. This requirement would cushion most of the vegetation from serious damage, though adverse impacts would still be possible in some places because of the wide variety of terrain and climatic conditions and because the determination of adequate snow cover applies to relatively large areas.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions and their impacts are described under Alternative 1 (No Action-Alternative). Cumulatively, these actions have had a moderate adverse impact on vegetation. The implementation of Alternative 4 would result in additional minor adverse impacts on vegetation and wetland resources; therefore, the total cumulative adverse impact on vegetation and wetland resources would continue to be moderate.

Conclusion

Under Alternative 4, adverse impacts on vegetation and wetlands would be minor. Trail improvement and maintenance would cause the continued vegetation loss on a total of 7 acres within primarily dwarf birch shrublands and spruce-willow/alder woodlands, including 0.4 acres of wetland vegetation. If snowmobiles were used for a winter subsistence moose hunt, there is the possibility of vegetation damage from their use; however, regulations requiring adequate snow cover would minimize these impacts.

The level of impact under this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.5 WILDLIFE

4.5.1 Wildlife Impact Methodology

The principal method for the impact analysis involved a review of published and unpublished literature regarding the effects of human activities on wildlife mortality and disturbance. In addition to literature review, the impact analyses were based on observations by park employees, discussions with residents, and best professional judgment based on previous experience with similar projects and activities.

4.5.2 General Wildlife Impacts

Moose and caribou populations can be reduced by hunting. At some point, reduction in numbers of animals leads to decreased fitness of moose or caribou populations. Additionally, it's been proposed that the hunting of trophy sheep can have evolutionary consequences on sheep populations, selecting for those with smaller horns because they survive to breed (Coltman, et al. 2003).

Noise from helicopters, airplanes, and ORVs could disturb moose, caribou, and other wildlife by causing behavioral or physiological changes (Klein 1973, Frid and Dill 2002, Lawler et al. 2005, AXYS Environmental Consulting 2001, Gaines et al. 2003). Based on the experience of park staff who regularly use helicopters and airplanes to facilitate research on wildlife in the park, large mammals appear more affected by helicopter noise than by other noise sources (NPS 2006b). For example, a grizzly or black bear is much more likely to run from helicopter noise, even when the noise is a great distance away, while the same bear is likely to tolerate airplane noise at much closer range.

During winter, snowmachine tracks funnel movements of wolves making them easier to find (Thurber et al. 1994, James and Stuart-Smith 2000). This effect could increase the harvest of wolves in the TUA.

4.5.3 Impacts to Wildlife Under Alternative 1 (No Action)

The Cantwell TUA would remain open to the use of ORVs by NPS qualified subsistence users for subsistence purposes. ORV use for subsistence purposes would occur at anytime with any type of machine. However, use would be concentrated along Cantwell Creek, Cantwell Airstrip Trail and the Windy Creek trails.

Actions in this alternative would have a major adverse impact on moose in the Cantwell TUA because levels of harvest would increase dramatically over the current average of 5 moose per year. In addition, noise from motorized equipment would disturb wildlife in general, causing minor impacts.

Moose Mortality

More subsistence moose hunters would be expected to use the TUA than in the past, and we can assume the 50 households that hunt would go to the TUA first because:

a) The *2005 NPS Cantwell Subsistence Traditionally Employed ORV Determination* removed any ambiguity about whether ORV use for subsistence purposes is authorized in the TUA;
b) The TUA is right next to Cantwell;

c) Subsistence hunting in the TUA is unaffected by competition with non-local hunters (unlike on lands outside the TUA);
d) There would be continued improvements in the reliability of the ORVs themselves; and
e) The TUA is open earliest and latest for moose.

This means as many as 50 households could use ORVs to scope for moose throughout the TUA before and during hunting season. Given that number (and also assuming that there is the right combination of cold enough weather early enough in the season to bring the bull moose into rut so they aggregate up with the cows in the middle to lower portions of the draws and drainages, putting them in much more accessible places for hunters to reach, and often putting the moose into more visible places), harvests in the TUA would be expected to initially increase over the current average of 5 moose.

For the purposes of this analysis, the NPS assumes harvest levels would initially double up to 10 moose. These numbers are high enough to potentially affect the health of moose populations in the TUA. In a November 2005 moose survey that encompassed a 55.8 square mile area that approximately corresponds to the TUA, 11 large bulls, 11 medium bulls and 7 yearling bulls were counted, along with 65 cows and 8 calves (NPS 2005b). If 10 bull moose were harvested out of a total of 29 bulls, then 34% of the bull moose population in the TUA would be removed. Removal of this many bulls could negatively affect fitness of the local population. There are limits to how uneven the sex ratio can get without jeopardizing the opportunities of all females to be bred. We don't know what those limits are. However, the selective (or random) removal of all but a few male moose would have the effect of breaking down the selective process, so that moose that would normally not have bred might have a large reproductive advantage. It would be difficult for the NPS to say it is maintaining natural and healthy wildlife populations if it allows human harvest to cause significant changes in sex ratio or other population parameters.

Between 1995-2003 conditions of the Federal Subsistence Registration Permits specified that the Bull River and Cantwell Creek drainages were closed to ORV use. The Bull River and Cantwell Creek drainages are believed to provide large areas of good moose habitat. Opening these areas to ORV use under this alternative would contribute to the doubling of current moose harvests because access to these potentially moose-rich areas would be greatly facilitated by permitting ORVs in these areas.

Wildlife Disturbance

This alternative assumes administrative helicopter, airplane, and ORV use for monitoring purposes, and a high level of ORV use for subsistence purposes during hunting season and prior to hunting season. It is assumed that this alternative would have the highest amount of administrative helicopter and ORV use. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won’t occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Wildlife would be expected to return to areas of disturbance once the disturbance is removed. Some individuals would be temporarily displaced but the duration and frequency of noise events is not expected to cause any population-level impacts.

Cumulative Impacts

The following past, present, or reasonably foreseeable actions would affect wildlife in the TUA:

- ANILCA allows snowmachines for subsistence, for traditional activities, and for travel to and from villages and homesites (ANILCA 811 and 1110). During the 1990s, technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali. Accurate estimates of snowmachine users are difficult to make, but during March and April of 1999, the NPS estimated that there were between 1,500 and 2,000 snowmobile users along the Parks Highway, primarily in the region from Cantwell to the West Fork of the Chulitna River and the Tokositna River area (NPS 2000a).

- The National Park Service and its partners use motorized transportation for research. This contributes noise to the backcountry.

- Past use of ORVs in the TUA has created many trails that exist today. Use of ORVs on these trails has contributed to noise disturbance to wildlife.

Due to noise disturbance caused by helicopters, airplanes, ORVs, and snowmachines, these past, present, and future actions would have a moderate adverse impact on wildlife in the TUA. The actions in this alternative would add major negative impacts due to higher rates of mortality. The cumulative impact of this alternative plus these past, present, and future actions would be major. Noise could occur year-round and for the duration of this plan, but noise impacts would be unlikely to cause any significant population-level impacts. This alternative would be responsible for a substantial portion of the adverse impacts primarily due to the increase in harvest levels.

Conclusion

Actions in this alternative would have a major adverse impact on moose in the Cantwell TUA because levels of harvest would increase dramatically over the current average. Sex ratios or other population parameters could be changed as a result. In addition, noise from motorized equipment would disturb wildlife in general.

The level of impacts to wildlife anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.5.4 Impacts to Wildlife Under Alternative 2

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on NPS-managed trails and routes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). Both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year could increase above the current average

of 5 moose/year. The number of harvests would be capped to maintain natural and healthy populations. Noise from helicopters, airplanes, and ORVs would disturb wildlife.

Moose Mortality

Moose harvests in the TUA would at least continue to average 5 moose harvested/year (based on past 15-year average) or could increase up to set harvest limit levels. This is because:

More subsistence moose hunters would be expected to use the TUA than in the past, and we can assume the 50 households that hunt would go to the TUA first because of the reasons listed under Alternative 1.

ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. Construction of the Bull River Access Trail would open more territory to subsistence hunters and the maintained identified trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

This means as many as 50 households could use ORVs on NPS-managed trails and routes to scope for moose primarily in August and September, as they have in the past. For purposes of this analysis we also assume that there is the right combination of cold enough weather early enough in the season to bring the bull moose into rut so they aggregate up with the cows in the middle to lower portions of the draws and drainages, putting them in much more accessible places for hunters to reach, and often putting the moose into more visible places.

These factors would encourage concentrated hunting along the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail, Upper Cantwell Creek Floodplain Trail/Route, and Bull River Floodplain Trail/Route. These trails and routes occur in habitat that is preferred by moose. Since ORVs would be restricted to NPS-managed trails and routes for scouting moose and caribou, it is likely that more moose would be harvested closer to trails. Greater numbers of moose harvested near trails could affect local moose populations along the Bull River, Cantwell Creek, and Windy Creek trails and routes, though local populations may be replenished with moose from other places that would move into this available habitat.

The Bull River and Cantwell Creek drainages are believed to provide large areas of good moose habitat. Facilitating use of these areas under this alternative would contribute to increased moose harvests because access to these potentially moose-rich areas would be greatly facilitated by permitting ORVs in these areas; however, there would be some restrictions on ORV use in these areas (such as going off-trail only to retrieve an animal).

Off-trail use would be more challenging due to the restrictions imposed in this alternative; however, it is assumed that regardless of the closures and other restrictions, many hunters would drive ORVs off-trail to retrieve harvested moose/caribou, and there would be some level of impact from this use.

Overall, more subsistence hunters could result in increased harvests in the TUA over the current average of 5 moose per year. However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. So while the number of harvests could increase

slightly, the number of animals harvested per year would not negatively affect the health of moose populations in the TUA.

Wildlife Disturbance

This alternative assumes administrative helicopter, airplane, and ORV use for monitoring purposes, and a high level of ORV use for subsistence purposes during hunting season and prior to hunting season. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Wildlife would be expected to return to areas of disturbance once the disturbance is removed. Some individuals would be temporarily displaced but the duration and frequency of noise events is not expected to cause any population-level impacts.

Cumulative Impacts

Cumulative impacts on wildlife resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. Due to noise disturbance caused by helicopters, airplanes, ORVs, and snowmachines, these past, present, and future actions would have a moderate adverse impact on wildlife in the TUA. The actions in this alternative would add additional noise disturbance from ORVs, airplanes, and helicopters. The cumulative impact of this alternative plus these past, present, and future actions would also be moderate as impacts could occur year-round and for the duration of this plan, but impacts are not likely to cause any significant population-level impacts. This alternative would be responsible for a considerable portion of the adverse impacts, particularly during summer and fall when noise from motorized use would be greatest.

Conclusion

Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year would increase above the current average of 5 moose/year. The number of harvests would be capped to maintain natural and healthy populations. Noise from helicopters, airplanes, and ORVs would disturb wildlife but is not expected to cause any population-level impacts.

The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.5.5 Impacts to Wildlife Under Alternative 3

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. Instead, the NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified

subsistence users for all subsistence purposes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). The Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year would increase above the current average of 5 moose/year, and the number of wolves harvested would likely increase, though the number of harvests would be monitored and, if necessary, a limit would be proposed to maintain natural and healthy populations. Noise from helicopters, airplanes, ORVs, and snowmachines would disturb wildlife.

Moose and Wolf Mortality

Moose harvests in the TUA would at least continue to average 5 moose harvested/year (based on past 15-year average) or could increase up to set harvest limit levels. This is because more subsistence moose hunters would be expected to use the TUA than in the past because of the reasons listed under Alternative 1. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. Construction of the Bull River Access Trail would open more territory to subsistence hunters and the maintained identified trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

We can assume the 50 Cantwell households that hunt would go to the TUA first due to the reasons listed under Alternative 1. This means as many as 50 households could use ORVs on NPS-managed trails and routes to scope for moose before and during hunting season. For purposes of this analysis we also assume that there is the right combination of cold enough weather early enough in the season to bring the bull moose into rut so they aggregate up with the cows in the middle to lower portions of the draws and drainages, putting them in much more accessible places for hunters to reach, and often putting the moose into more visible places.

These actions would encourage concentrated hunting along the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail, Upper Cantwell Creek Floodplain Trail/Route, and Bull River Floodplain Trail/Route. These trails and routes occur in habitat that is preferred by moose. This assumption is supported by US Fish and Wildlife Service records that identify 4 moose harvested by NPS qualified subsistence users within the TUA in 2005 and 3 moose harvested in the TUA in 2006 -- both years when a temporary ORV closure was in place on all but three trails/routes in the TUA. Since ORVs would be restricted to NPS-managed trails and routes, it is likely that more moose would be harvested closer to trails. Greater numbers of moose harvested near trails could affect local moose populations along the Bull River, Cantwell Creek, and Windy Creek trails and routes, though local populations may be replenished with moose from other places that would move into this available habitat.

Increased/concentrated ORV traffic on NPS-managed trails/routes may displace moose away from the trails and make it more difficult for hunters to kill moose from trails; however, some hunters would be able to call a moose to bring it closer to accessible areas before killing it and other hunters would just wait until the bull gets a reasonable distance to the trail. We also assume that most subsistence hunters would be able to hike at least ½ mile to pack a harvested moose back to an ORV parked on NPS-managed trails/routes or outside the park boundary.

The Bull River and Cantwell Creek drainages are believed to provide large areas of good moose habitat. Opening these areas to ORV use under this alternative would contribute to increased moose harvests because access to these potentially moose-rich areas would be greatly facilitated by permitting ORVs in these areas; however, there would be some restrictions on ORV use in these areas (such as having to stay on trails/routes).

Subsistence hunters would have additional opportunities to hunt moose during a winter hunt. Snowmachines would facilitate the hunt because snowmachines can cover more ground and access more moose habitat in a shorter period of time than an ORV or a hunter on foot. Providing a winter hunt would increase harvests because there are few other hunting opportunities in winter, snowmachines provide broader access than other means of transportation, cold weather makes it easier to prevent meat spoilage, snow cover provides an ideal substrate for clean handling of meat, and snowmachines and sleds provide an easier way to transport meat. The advantages of hunting by snowmachine (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) are likely to result in greater hunter participation and higher harvest levels. Assuming about 50 households in Cantwell say they try to hunt moose, and further assuming about half are successful in the summer, then the remaining 25 households would likely take advantage of the expanded winter moose hunt. This means about 25 additional snowmachine groups may use the traditional use area for the winter hunt.

While greater use would be expected on established trails in the fall and throughout the TUA in the winter, no use would occur off-trail during the fall. Therefore, off-trail areas would get very little use and few, if any, animals would be harvested in these areas during the fall hunting season.

Overall, more subsistence hunters could result in increased harvests in the TUA over the current average of 5 moose per year. However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy moose populations on park land within the TUA. So while the number of harvests could increase slightly, the number of animals harvested per year would not negatively affect the health of moose populations in the TUA.

A winter hunt would also facilitate opportunistic hunting of wolves because more hunters would be active in winter. There would be greater potential for wolf harvest because it’s easier to track wolves on snow and the winter landscape makes it easier to spot wolves than in summer when vegetation hides the wolves. Because of these factors, there is potential for a winter season hunt to affect wolf populations in the TUA; however, the National Park Service would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit. Such measures would ensure that impacts to wolf populations would be minimal.

Wildlife Disturbance

This alternative assumes administrative helicopter, airplane, and ORV use for monitoring purposes, and a high level of ORV use for subsistence purposes during hunting season and prior to hunting season. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic

mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Wildlife would be expected to return to areas of disturbance once the disturbance is removed. Some individuals would be temporarily displaced but the duration and frequency of noise events is not expected to cause any population-level impacts.

A winter hunt would introduce additional snowmachine use in the area. Noise from snowmachines would disturb wildlife throughout the winter, though it is not likely that the duration and frequency of snowmachine use that would occur for subsistence purposes would have any lasting impact on any wildlife population in the TUA because of the dispersed and temporary nature of the disturbance and the amount of snowmachine use that the hunt would produce, in comparison to existing levels of snowmachine use that occurs in the area for non-subsistence purposes.

Cumulative Impacts

Cumulative impacts on wildlife resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. Due to noise disturbance caused by helicopters, airplanes, ORVs, and snowmachines, these past, present, and future actions have a moderate adverse impact on wildlife in the TUA. The actions in this alternative would add additional noise disturbance from ORVs, airplanes, helicopters, and snowmachines. The cumulative impact of this alternative plus these past, present, and future actions would also be moderate as impacts could occur year-round and for the duration of this plan, but impacts are not likely to cause any significant population-level impacts. This alternative would be responsible for a considerable portion of the adverse impacts, as moose harvest levels would increase and additional noise would be introduced throughout most of the year.

Conclusion

Actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year would increase above the current average of 5 moose/year, and the number of wolves harvested would likely increase, though the number of harvests for moose and wolves could be capped to maintain natural and healthy populations. Noise from helicopters, airplanes, ORVs, and snowmachines would disturb wildlife.

The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.5.6 Impacts to Wildlife Under Alternative 4

There would be no off-trail use of ORVs for subsistence or any other purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users

for all subsistence purposes *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail.

Actions proposed in this alternative would have a minor adverse impact on wildlife in the TUA because the number of moose harvested would remain close to the current average of 5 moose per year, and the number of harvests would be capped to maintain natural and healthy populations. Wolves would be negatively impacted with the addition of a winter hunt, but the number of harvests would be monitored and, if necessary, a limit would be proposed to maintain natural and healthy populations. Noise from administrative use of helicopters, airplanes, ORVs, and snowmachines would disturb wildlife.

Moose and Wolf Mortality

Moose harvests in the TUA would continue to average 5 moose harvested/year (based on past 15-year average). This is because factors that would cause harvests to increase would be offset by factors that would cause harvests to decrease.

More subsistence moose hunters would be expected to use the TUA than in the past because of the reasons listed under Alternative 1. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition.

We can assume the 50 Cantwell households that hunt would go to the TUA first due to the reasons listed under Alternative 1 . This means as many as 50 households could use ORVs on NPS-managed trails and routes to scope for moose one week before and during hunting season. For purposes of this analysis we also assume that there is the right combination of cold enough weather early enough in the season to bring the bull moose into rut so they aggregate up with the cows in the middle to lower portions of the draws and drainages, putting them in much more accessible places for hunters to reach, and often putting the moose into more visible places.

These actions would encourage concentrated hunting along the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, and Cantwell Airstrip Trail. These trails occur in habitat that is preferred by moose. This assumption is supported by US Fish and Wildlife Service records that identify 4 moose harvested by NPS qualified subsistence users within the TUA in 2005 and 3 moose harvested in the TUA in 2006 -- both years when a temporary ORV closure was in place on all but three trails/routes in the TUA. Since ORVs would be restricted to NPS-managed trails for scouting moose and caribou, it is likely that more moose would be harvested closer to trails. Greater numbers of moose harvested near trails could affect local moose populations along the trails, though local populations may be replenished with moose from other places that would move into this available habitat.

Since the Bull River and Upper Cantwell Creek Floodplains would not be open to ORV use, hunters would be limited to ORV use on four NPS-managed trails in the eastern part of the TUA. The Bull River and Cantwell Creek drainages are believed to provide large areas of good moose habitat. Closing these areas to ORV use under this alternative would lead to decreased moose harvests because access to these potentially moose-rich areas would be much more difficult.

Increased/concentrated ORV traffic on NPS-managed trails/routes may displace moose away from the trails and make it more difficult for hunters to kill moose from trails; however, some hunters would be able to call a moose to bring it closer to accessible areas before killing it and other hunters would just wait until the bull gets a reasonable distance to the trail. It is also

assumed that most subsistence hunters would be able to hike at least ½ mile to pack a harvested moose back to an ORV parked on NPS-managed trails/routes or outside the park boundary.

Subsistence hunters would have additional opportunities to hunt moose during a winter hunt. Snowmachines would facilitate the hunt because snowmachines can cover more ground and access more moose habitat in a shorter period of time than an ORV or a hunter on foot. Providing a winter hunt would increase harvests because there are few other hunting opportunities in winter, snowmachines provide broader access than other means of transportation, cold weather makes it easier to prevent meat spoilage, snow cover provides an ideal substrate for clean handling of meat, and snowmachines and sleds provide an easier way to transport meat. The advantages of hunting by snowmachine (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) are likely to result in greater hunter participation and higher harvest levels. Assuming about 50 households in Cantwell say they try to hunt moose, and further assuming about half are successful in the summer, then the remaining 25 households would likely take advantage of the expanded winter moose hunt. This means about 25 additional snowmachine groups may use the traditional use area for the winter hunt.

While greater use would be expected on established trails in the eastern portion on the TUA in the fall and throughout the TUA in the winter, no use would occur off-trail during the fall. Therefore, off-trail areas would get very little use and few, if any, animals would be harvested in these areas during the fall hunting season.

Overall, more subsistence hunters and an additional winter hunt could result in increased harvests in the TUA over the current average. Limitations on the use of ORVs in the TUA (restricted to four trails and starting only one week prior to hunting season) could decrease chances of taking moose during fall. This alternative also proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy moose populations on park land within the TUA. This leads to the conclusion of an average of 5 moose per year taken in the TUA, the same as the current average. The number of animals harvested per year would not negatively affect the health of moose populations in the TUA.

A winter hunt would also facilitate opportunistic hunting of wolves because more hunters would be active in winter. There would be greater potential for wolf harvest because it’s easier to track wolves on snow and the winter landscape makes it easier to spot wolves than in summer when vegetation hides the wolves. Because of these factors, there is potential for a winter season hunt to affect wolf populations in the TUA; however, the National Park Service would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit. Such measures would ensure that impacts to wolf populations would be minimal.

Wildlife Disturbance

This alternative assumes administrative helicopter, airplane, and ORV use for monitoring purposes, and a high level of ORV use for subsistence purposes during hunting season but not during most of the summer. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative

helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Wildlife would be expected to return to areas of disturbance once the disturbance is removed. Some individuals would be temporarily displaced but the duration and frequency of noise events is not expected to cause any population-level impacts.

A winter hunt would introduce additional snowmachine use in the area. Noise from snowmachines would disturb wildlife throughout the winter, though it is not likely that the duration and frequency of snowmachine use that would occur for subsistence purposes would have any lasting impact on any wildlife population in the TUA because of the dispersed and temporary nature of the disturbance and the amount of snowmachine use that the hunt would produce, in comparison to existing levels of snowmachine use that occurs in the area for non-subsistence purposes.

Cumulative Impacts

Cumulative impacts on wildlife resulting from past, present, and reasonably foreseeable future actions would be the same as Alternative 1. Due to noise disturbance caused by helicopters, airplanes, ORVs, and snowmachines, these past, present, and future actions would have a moderate adverse impact on wildlife in the TUA. The actions in this alternative would add additional noise disturbance from airplanes, helicopters, ORVs, and snowmachines. The cumulative impact of this alternative plus these past, present, and future actions would also be moderate as impacts could occur year-round and for the duration of this plan, but impacts are not likely to cause any significant population-level impacts. This alternative would be responsible for a noticeable portion of the adverse impacts, particularly during summer and fall when administrative use of airplanes would be greatest, and during winter when snowmachines are used for an additional subsistence hunt.

Conclusion

Actions proposed in this alternative would have a minor adverse impact on wildlife in the TUA because the number of moose harvested would remain close to the current average of 5 moose per year, and the number of harvests would be capped to maintain natural and healthy populations. Wolves would be negatively impacted with the addition of a winter hunt, but harvest levels would be monitored and a limit proposed to maintain natural and healthy populations. Noise from administrative use of helicopters, airplanes, ORVs, and snowmachines would disturb wildlife but is not expected to cause any population-level impacts.

The level of impacts to wildlife anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.6 WATER RESOURCES

4.6.1 Water Resources Methodology

The principal method for the impact analysis involved a review of published and unpublished literature regarding the effects of human activities on water quality, stream morphology, and

aquatic species. In addition to literature review, the impact analyses were based on observations by park employees, discussions with residents, and best professional judgment based on previous experience with similar projects and activities.

Information on fisheries in the Cantwell TUA was obtained by interviews and correspondence with fisheries biologists with the Alaska Department of Fish and Game, U.S. Fish and Wildlife Service, as well as from publications of the former agency, which is responsible for managing both sport and commercial fisheries in the State of Alaska. Predictions of impacts were made on the basis of a literature review of the generic impacts of ORVs and other agents of disturbance on fishery (particularly salmonid) resources. In addition, the predictions of impacts on TUA soils and vegetation in this EA were consulted, because as explained below, impacts to fisheries are closely related to predicted impacts on soil and vegetation resources.

Since there is little current information on the status of specific fish stocks in Bull River, Cantwell Creek, and Windy Creek, the discussion of impacts under each alternative below is perforce general and somewhat hypothetical. No surveys have ever been conducted in these streams and the most recent surveys from ADFG on lakes in the Cantwell Creek drainage are nearly 20 years old. As discussed in Chapter 3 of the EA, state and federal fisheries biologists have indicated that fisheries resources in these three watercourses appear to be limited.

4.6.2 General Water Resources Impacts

Off-road vehicle activity nearly always results in greatly increased erosion (Hinckley et al.1984). ORVs compact and disrupt the soil reducing infiltration capacity resulting in increased frequency and duration of runoff. ORV activity also destroys or disperses surface stabilizers creating relatively smooth trails that entrain surface flow and enhance runoff effectiveness (Meyer 2002). Off road vehicles can contribute large suspended sediment loads to receiving waters especially during storm events (Ayala et al.2005).

Brown (1994) determined that as vehicle traffic increased so did sediment deposited in streams. When ORVs cross tributaries in the TUA, ORVs loosen and displace soil material, making it susceptible to being washed into the drainage network to become sediment. Trails can also act as channels that multiply sediment loads to the stream network during runoff events. Travel routes can increase runoff due to compaction of the soil, decreased infiltration and lack of vegetation. These types of impacts would occur locally at ORV crossings on tributaries throughout the TUA. It is also important to note that USGS topographic maps show less than 40 miles of clear-flowing streams or tributaries in the TUA, and not all of these would be accessible to ORVs.

While to date there have been no investigations on the effects of ORVs on aquatic resources in Denali National Park or in similar ecosystems, Rinella evaluated impacts from ORV crossings on clearwater streams on the Kenai Peninsula, Alaska, with relatively heavy and concentrated ORV use (Rinella et al 2003). He found that:

> Biological impacts from sedimentation are pervasive and occur at every trophic level within the stream ecosystem. Increased turbidity limits light penetration, which can greatly decrease the primary productivity of benthic algae, the base of the stream food web (Lloyd et al 1987). Sediment can further reduce algal stocks by scouring and smothering (Van Nieuwenhuyse et al., 1986). Sedimentation can limit macroinvertebrate abundance through a reduction in algal food resources, mechanical scouring, and smothering when fine particles fill interstitial spaces in the streambed (Rosenberg et al 1978).

When operating within a watercourse or wetland of the Cantwell TUA, ORVs can have both direct and indirect adverse impacts on fishery resources. A direct impact would occur if an ORV were to actually run over and crush fish (juvenile or adult) or fish eggs. Healthy fish would be expected to be sufficiently swift and agile to evade an oncoming vehicle, but fish preoccupied with or exhausted from spawning could actually be at risk from a fast-moving ATV. Furthermore, fish eggs are sessile (immobile) and would also be potentially vulnerable to damage or lethal crushing from even a single pass of an ORV (Copper River Watershed Project, no date; Sowl and Poetter, 2004). Even if eggs were not crushed directly beneath a tire or tread, the displacement of gravel, rocks, and sand substrates around fish nests (redds) could damage egg development and viability. The indirect adverse impact would result from stirring up sediments when an ORV is within the water body itself.

Another general, indirect impact is that of disturbance, which is important in determining the character of aquatic communities, their structure, and their persistence. Disturbance tends to induce a simplifying effect on aquatic biota: reducing species diversity and simplifying trophic interactions until, at some point, certain species are unable to adapt and disappear from the modified environment. These can include more desirable species, such as sport fish, and rare or imperiled species. The vegetation and substrates at repeated crossing sites are disrupted; this in turn changes the nature of the benthic (bottom-dwelling) fauna, detrimentally affecting higher trophic levels, that is, those fish that feed on benthic macroinvertebrates such as worms, nymphs, and crustaceans. Shallow water areas, which may be more readily used or crossed by ORVs, often represent breeding sites for certain species during different parts of the year. These same areas often serve as nurseries for fish species throughout the year. Finally, the invertebrates found in shallow aquatic habitats are often diverse and abundant; these provide foods for many fish, including sport fish (TCAFS, 2005).

Even when ORVs are driven across uplands rather than directly through shallow water, especially if that land is sloped or in close proximity to waters, such as stream banks, ORV use can produce indirect, adverse impacts on fisheries. This potential indirect impact of ORVs on fisheries is a direct function of their impacts on soils and vegetation. As described in the soils section earlier in chapter 4, the shearing, abrasion, and compaction of the ground surface from tires or treads that can occur along an ORV route weaken the structural integrity of the soils, leading to rutting and, during rain events, erosion. Soil particles transported by sheet or rill water erosion are eventually carried downhill to water bodies with either standing or flowing water (e.g. ponds, lakes, streams, rivers). At first these particles, especially finer (smaller) ones like clays, are suspended, causing turbidity – muddy, cloudy, or opaque water. Sooner or later, depending on particle size and the kinetic energy of the water, the particles are deposited on the bed or substrate (bottom) of the water body. Higher velocity currents would tend to carry suspended sediments some distance before depositing them, while slower currents or slack water would allow the fine suspended particles to settle out sooner and over a smaller area.

At high enough levels, turbidity or suspended sediments alone may cause problems directly for fish. In one laboratory study, coho salmon exposed to high concentrations of suspended solids experienced observable signs of stress, such as rapid opercular and cough rates, as well as sediments that accumulated on the ends of their gill filaments, apparently interfering with respiration. In the same experiment, the ability of cohos to capture prey as decreased markedly as turbidity increased (Cederholm and Reid, 1979). Suspended sediments abrade the gills of fish and interfere with feeding because the fish have difficulty locating their prey or food (Parks Canada, 2005). Alaska Administrative Code (18 AAC 70) specifies that turbidity standards for fish, aquatic life and wildlife may not exceed 25 NTU above natural conditions.

The Alaska Department of Fish and Game states that the introduction of fine sediments to streams is one of the major human-induced impacts to stream and fishery resources in the state, and identifies ORV trails as a source of this introduction, along with timber harvest, roads, and development (Wiedmer, 2002). Sediments may clog the interstitial spaces of spawning gravels, thus reducing the reproductive success of fish species that are important both socially and commercially. Sedimentation may also reduce primary and secondary aquatic production, narrowing the base of the aquatic food pyramid and thus reducing the growth and survival of fish. Furthermore, ford or crossing sites in particular often destabilize stream banks and may block fish passage because of increased width/depth ratios (Wiedmer, 2002).

The introduction of sizeable quantities of silt to spawning streams adversely affects fish survival by reducing the permeability of gravel and interfering with the delivery of water and oxygen to incubating eggs and alevins (newly hatched fish that still have a yolk sac) (Washington Department of Fish and Wildlife, 2000). Fine sediments eroded from stream banks or transported from upstream can smother incubating fish eggs (Beck, 2006; Copper River Watershed Project, no date; Cederholm, et al., 1980). In addition, damage to streamside vegetation can reduce shade and result in higher water temperatures, which stress cold water habitat fish (Beck, 2006).

As discussed in Chapter 3, the fishery resources of the three major affected watercourses within the Cantwell TUA – Bull River, Cantwell Creek, and Windy Creek – appear to be rather marginal. These three streams support neither outstanding fish populations nor outstanding recreational fisheries (Brase, 2007a, 2007b; Rutz, 2007). Chapter 3 also indicated that the Cantwell Creek watershed contains several ponds and lakes that have supported both natural fish populations, including sport fish such as lake trout, as well as sport fisheries, over the years. This suggests that Cantwell Creek itself, in spite of being glacially occluded, contains fish, if only in limited numbers or seasonally as transients, as they migrate to and from spawning grounds, rearing and feeding areas, new habitat, etc. The marginal condition of the fishery is a consideration in the impact ratings that follow.

It should be noted, however, that since these lakes all drain into Cantwell Creek, that is, are upstream of it, they would be unaffected by turbidity and sedimentation problems in the creek itself.

4.6.3 Impacts to Water Resources Under Alternative 1 (No Action)

Under Alternative 1, it is expected that subsistence-related ORV travel would continue to occur on the existing trails as well as many off-trail areas throughout the TUA. Travel on the Windy Creek, Cantwell Creek and Bull River Floodplains would also be expected. No restrictions would be placed on the landscapes of the TUA that could be used for ORV travel, and thus, over time, travel could extend well beyond the areas currently mapped with ORV impacts, particularly on the lower elevation, wetland-shrubland mosaics similar to those that have been extensively trafficked for hunting to date (Liebermann and Roland 2006). ORV use would not be limited to access for hunting, but could also be used to support any other subsistence activity.

The analysis below shows that impacts to water quality, channel morphology, and aquatic species would be minor to moderate because use of ORVs would negatively affect turbidity, bank stability, and aquatic species of the few clear-flowing streams and tributaries within the TUA; however, impacts would largely be confined to crossing sites and impacts would not affect the overall health of the ecosystem.

More subsistence moose hunters would be expected to use the TUA than in the past, and we can assume the 50 households that hunt would go to the TUA first because:

a) The *2005 NPS Cantwell Subsistence Traditionally Employed ORV Determination* removed any ambiguity about whether ORV use for subsistence purposes is authorized in the TUA;
b) The TUA is right next to Cantwell;
c) Subsistence hunting in the TUA is unaffected by competition with non-local hunters (unlike on lands outside the TUA);
d) There would be continued improvements in the reliability of the ORVs themselves; and
e) The TUA is open earliest and latest for moose.

This means as many as 50 households could use ORVs to scope for moose and caribou throughout the TUA before and during hunting season. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Since there would be no restriction on where ORVs could be driven within the TUA, and there would be no restrictions related to the condition of the soil or the weather, there would be an increased level of damage to the soil resources within the TUA due to increased travel through and damage to wetlands and increased parallel trail formation while evading trail obstacles. The increase in the area and volume of soils disturbed by ORVs under this alternative would proportionately increase the material exposed to erosion, transport, and subsequent sedimentation in water bodies.

Impacts to water resources would occur wherever ORVs travel off-trail and cross clear-flowing streams or tributaries, or when ORVs travel on existing alignments that are not sustainable. Actions proposed in this alternative could increase turbidity, decrease bank stability, and negatively affect individual macroinvertebrates and fish at ORV crossings but because crossings would be widely dispersed throughout the TUA and impacts would be confined to the crossing site, at the time of the crossing, impacts would not affect overall health of any population of macroinvertebrate or fish species. USGS topographic maps show less than 40 miles of clear-flowing streams or tributaries in the TUA and not all of these are accessible to ORVs.

As described in the generic impacts section above, introducing fine suspended sediments into water bodies has a detrimental effect on aquatic ecosystems, and in particular fish. Suspended sediments may harm fish directly by abrading their gills, inhibiting respiration, and interfering with their feeding; deposition of suspended sediments (i.e. sedimentation) may harm fish stocks indirectly through potentially inhibiting their reproduction by smothering incubating eggs in gravel and other substrates. Species that could potentially be affected to some extent include coho salmon and Dolly Varden in the Bull River and grayling in Cantwell and Windy creeks. It is unknown if any of these species spawn in the streams in question, but they may be present occasionally or as transients. In addition, at least some of the other species described in Chapter 3 – including lake trout, burbot, whitefish, and sculpin – may occur in ponds or lakes that might be subjected to some degree of sedimentation; these species could thus potentially be adversely affected by this alternative.

The greatest impact to moving water resources would occur along the Windy Creek Access Trail where unchecked erosion currently occurs along the trail alignment. Stream capture is a geomorphic phenomenon that occurs when a stream or river from a neighboring drainage system or watershed erodes through the divide between two streams and "captures" another stream which then is diverted from its former bed and now flows down the bed of the capturing stream. While widespread stream capture is unlikely to occur throughout the TUA, active stream capture would continue to occur on Windy Creek North, in the ravine on the Windy Creek Access Trail, and

also on areas of the Cantwell Creek Northeast Trail. Collection and drainage mechanisms would continue to occur along the Windy Creek Access Trail alignment in the ravine and this contributes to water flow along the alignment as well (NPS 2007). Collection and drainage is also a potential problem along the Windy Creek Bowl alignment (NPS 2007). During spring thaw and periods of rain and heavy use, sediment is transported along the fall-line into Windy Creek. Increased use of this trail would exacerbate this sediment transport, which causes the impacts to water quality, channel morphology, and aquatic species that are described in the General Impacts section.

Use of ORVs along and across the Upper Cantwell Creek Floodplain would contribute small amounts of sediment into Cantwell Creek. ORV travel would have minimal impact to gravel bar morphology because gravel bars are by nature highly dynamic and the gravel surface is generally resistant to surface impact. In addition, travel over barren gravel bars is not generally restricted in any single track; therefore use is dispersed over a wide area.

Similar impacts would occur where ORVs cross the Bull River, though this area is currently difficult to access; consequently, impacts would be few and of low intensity.

Cumulative Impacts

The following past, present, or reasonably foreseeable actions would affect water resources in the TUA:

- Past use of ORVs in the TUA has created many trails that exist today. Use of ORVs on these trails has contributed to erosion.

- Past motor vehicle use in the TUA has resulted in the loss of 14.8 ha (~37 acres) of vegetation. Loss of vegetation could contribute to erosion and degraded water resources.

Due to erosion in the TUA caused by past use of motorized vehicles, these past actions would have a minor adverse impact on water resources in the TUA. The actions in this alternative would contribute minor to moderate adverse impacts due to ORVs crossing clear-flowing tributaries in the TUA. The cumulative impact of this alternative plus these past actions would be minor as impacts would not affect the overall health of the ecosystem. This alternative would be almost entirely responsible for the adverse impacts.

Conclusion

Impacts to water quality, channel morphology, and aquatic species would be minor to moderate because use of ORVs would negatively affect turbidity, bank stability, and aquatic species within the TUA; however, impacts would largely be confined to crossing sites and impacts would not affect the overall health of the moving water ecosystems. An increase in turbidity, sediment transport, suspended sediments, and sedimentation would be expected in Bull River, Cantwell Creek, Windy Creek, certain tributaries, wetlands, and possibly small ponds and lakes. Increased introduction of sediments into the TUA's water bodies would, in turn, adversely impact the relatively unexceptional fishery resources that may be present.

These resources fulfill several of the specific purposes identified in the legislation of the 1980 park additions, including the preservation of lands and waters for present and future generations, maintenance of sound habitat for wildlife (including fish), and the preservation of extensive

unaltered ecosystems in their natural state. The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.6.4 Impacts to Water Resources Under Alternative 2

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on NPS-managed trails and routes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). Both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

The analysis below shows that impacts to water quality, channel morphology, and aquatic species would be moderate for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the TUA. Soils in the vicinity of the new Bull River Access Trail and Bull River and Upper Cantwell Creek Floodplains would be potentially vulnerable to erosion, and thus, capable of impacting aquatic resources including the modest fish stocks potentially present. Impacts would be minor after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would be somewhat restricted, monitoring degradation levels would mitigate damage, and impacts would be confined to where ORVs cross streams and tributaries.

More subsistence hunters would be expected to use the TUA than in the past because of the reasons listed in Alternative 1. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. Construction of the Bull River Access Trail would open more territory to ORV use and the maintained identified trails would attract more subsistence hunters because they would be in better condition and easier to drive on. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Off-trail use would be more challenging due to the restrictions imposed in this alternative; however, it is assumed that regardless of the closures and other restrictions, many hunters would drive ORVs off-trail to retrieve harvested moose/caribou, and there would be some level of impact from this use. Because the level of ORV use would be expected to increase under this alternative, impacts to water resources would also be expected to increase. However, actions proposed in this alternative would mitigate many of those impacts, as described below.

Impacts to water resources would occur wherever ORVs travel off-trail and cross streams or tributaries. Under Alternative 2 these impacts would occur locally at crossings on tributaries that are within the portion of the TUA that would initially be open for ORV use. However, if future long-term studies find that ORVs designed with best available technology have minimal impacts on saturated soils or steeper slopes and that such impacts would be below the warning or action degradation levels proposed under this alternative, then they may be allowed across a larger area of the TUA. Riding ORVs across tributaries would exacerbate sediment transport, which causes the impacts to water quality, channel morphology, and aquatic species that are described in the General Impacts section. Impacts would not affect the health of the ecosystem because use of ORVs would be dispersed over a large area.

Impacts would also be mitigated by managing access when necessary in response to conditions reaching warning or action degradation levels, which include evidence of persistent sedimentation immediately below an ORV soft-substrate stream crossing (warning level), and evidence of persistent sedimentation 20 meters or more below an ORV soft-substrate stream crossing (action level). This monitoring and action scheme would ensure impacts would not become major in any location.

Implementation of hardened trail surfaces and other mitigation measures would likely occur within 1-4 years. In the meantime, these trails would continue to be used without mitigation, so impacts to water resources during those 1-4 years would be similar to impacts that would occur along these trails under Alternative 1 (increased sediment transport in Windy Creek and clear-flowing tributaries).

Actions proposed in this alternative would encourage concentrated use along the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail, Upper Cantwell Creek Floodplain Route/Trail, and Bull River Floodplain Route/Trail. Continued subsistence ORV use of the designated trails would likely concentrate many of the impacts to those trails; however, as described in the soils section of Chapter 4, these four existing trails are among those with the least existing soils impacts (see Table 3.1). These trails would be made even more durable as a result of construction improvements made as prescribed for this alternative in Chapter 2. After implementation, stream capture, collection and drainage that would occur on trails under Alternative 1 would not occur in this alternative because the trails or trail sections that would be impacted in Alternative 1 would be either closed or improved to control erosion in this alternative. This in turn, would reduce the potential for introduction of suspended sediments into water bodies, and subsequent adverse impacts on any macroinvertebrates or fish stocks that may be present.

Gravel capping done as part of trail construction in the Bull River and Upper Cantwell Creek Floodplain may require gravel extraction from the active floodplain. However, any volumes of gravel removed from these floodplains would likely be replenished through natural sediment deposition within a short timeframe. In addition, trail segments and routes within the Bull River or Upper Cantwell Creek Floodplain would involve approximately 30 crossings of the main Bull River channel and secondary channels, and 35 crossings of Cantwell Creek and secondary channels. These crossings would increase sedimentation in the glacial rivers.

Similar impacts would occur from construction of the new Bull River Access Trail. However, ORV use on a new Bull River Access Trail would have little effect on water resources because trail design would have mitigated erosion control. Sediments would be introduced at river crossings along the floodplain, but because the floodplain is gravel, and not a soil bank, turbidity impacts would be inconsequential. Coho salmon and Dolly Varden that may be present seasonally in Bull River would probably not be adversely affected.

Cumulative Impacts

In addition to the actions described in Alternative 1, it is foreseeable that NPS qualified subsistence users would use horses to pack out meat. As ORV use is restricted, more people would use horses, which can contribute fecal contaminants to streams and increase turbidity at crossings, but it is unlikely that they would have any profound impact on water resources.

Due to erosion in the TUA caused by past use of motorized vehicles and future horsepacking, these past and future actions would have a minor adverse impact on water resources in the TUA.

The actions in this alternative would contribute moderate adverse impacts due to trail construction and ORVs crossing clear-flowing tributaries in the TUA for up to 4 years. After construction is complete, adverse impacts would be minor. The cumulative impact of this alternative plus these past actions would be moderate in the near term and minor in the long term as impacts would not affect the overall health of the ecosystem. This alternative would be largely responsible for the adverse impacts.

Conclusion

Impacts to water quality, channel morphology, and aquatic species would be moderate for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the streams and tributaries in the TUA. Impacts would be minor after four years because NPS trail construction, maintenance and reinforcement activities, coupled with the more intensive monitoring included in this alternative, would minimize some of the potential soil impacts, including the potential for erosion and subsequent sedimentation in water bodies. Cross-country use of ORVs would be somewhat restricted, monitoring degradation levels would mitigate damage, impacts that did occur would be confined to places where ORVs cross streams and tributaries, and impacts would not affect overall health of the ecosystem.

The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.6.5 Impacts to Water Resources Under Alternative 3

There would be no off-trail use of ORVs for subsistence or any other purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). The Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes, and a trail/route would be constructed along these floodplains to facilitate access and protect resources.

The analysis below shows that impacts to water quality, channel morphology, and aquatic species would be minor to moderate for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the streams and tributaries in the TUA. Impacts would be minor after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would be prohibited, monitoring degradation levels would mitigate damage, and impacts that did occur would be confined to where ORVs cross streams and tributaries.

More subsistence hunters would be expected to use the TUA than in the past because of the reasons listed in alternative 1. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. This means as many as 50 households could use ORVs on NPS-managed trails and routes to scope for moose and caribou before and during hunting season. For the monitoring effort, the park would try to avoid using

ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Because the level of ORV use would be expected to increase under this alternative, impacts to water resources would also be expected to increase. However, actions proposed in this alternative would mitigate most of those impacts, as described below.

Under this alternative, ORVs would be used for subsistence purposes only on identified trails and routes. Because ORVs would not be crossing any clear-flowing streams or tributaries in the TUA off trail, there would be no impact to water resources in areas where there are no trails or identified routes.

Closing off-trail areas to ORV use would encourage concentrated use along the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail (new construction), Upper Cantwell Creek Floodplain Route/Trail, and Bull River Floodplain Route/Trail. Impacts to water resources would occur wherever these trails or routes cross streams or tributaries. In those areas, the types of impacts to water quality, channel morphology, and aquatic species would be the same as those described under Alternative 1. However, these trails and routes, including the sections of the Windy Creek Access Trail that are currently responsible for adding sediment to Windy Creek, would be maintained with the purpose of controlling erosion. Sediment-bearing water would be diverted off of trails so impacts to streams would be reduced. After implementation, stream capture, collection and drainage that would occur on trails under Alternative 1 would not occur in this alternative because the trails or trail sections that would be impacted in Alternative 1 would be either closed or improved to control erosion in this alternative.

The NPS-managed trails are among those areas with the least existing soils impacts (see Table 3.1), and these trails would be made even more durable as a result of construction improvements made as prescribed for this alternative. This action, coupled with trail condition monitoring and management, well defined and measured impact parameters, and limitations on the type and weights of ORVs, would greatly minimize soils impacts, and thus impacts on sedimentation rates and adverse effects to potentially occurring macroinvertebrates and fish that would be impacted by turbidity and sedimentation.

Gravel capping done as part of trail construction in the Bull River and Upper Cantwell Creek Floodplain may require gravel extraction from the active floodplain. However, any volumes of gravel removed from these floodplains would likely be replenished through natural sediment deposition within a short timeframe. In addition, trail segments and routes within the Bull River or Upper Cantwell Creek Floodplain would involve approximately 30 crossings of the main Bull River channel and secondary channels, and 35 crossings of Cantwell Creek and secondary channels. These crossings would increase sedimentation in the glacial rivers.

Similar impacts would occur from construction of the new Bull River Access Trail. However, ORV use on a new Bull River Access Trail would have little effect on water resources because trail design would have mitigated erosion control. Sediments would be introduced at river crossings along the floodplain, but because the floodplain is gravel, and not a soil bank, turbidity impacts would be inconsequential.

Impacts would also be mitigated by managing access when necessary in response to conditions reaching warning or action degradation levels, which include evidence of persistent sedimentation immediately below an ORV soft-substrate stream crossing (warning level), and evidence of persistent sedimentation 20 meters or more below an ORV soft-substrate stream crossing (action

level). This monitoring and action scheme would ensure impacts would not become major in any location.

The level of snowmachine use in the TUA would increase with a winter hunt. It is assumed that about 25 additional snowmachine groups may use the TUA for the winter hunt. Even with this increase, use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species. Snowmachines would not affect channel morphology because they travel above the surface of the stream.

Cumulative Impacts

In addition to the actions described in Alternative 1, it is foreseeable that NPS qualified subsistence users would use horses to pack out meat. As ORV use is restricted, more people would use horses, which can contribute fecal contaminants to streams and increase turbidity at crossings, but it is unlikely that they would have any profound impact on water resources.

Due to erosion in the TUA caused by past use of motorized vehicles and future horsepacking, these past and future actions would have a minor adverse impact on water resources in the TUA. The actions in this alternative would contribute minor to moderate adverse impacts due to trail construction and ORVs crossing streams and tributaries in the TUA for up to 4 years. After construction is complete, adverse impacts would be minor. The cumulative impact of this alternative plus these past actions would be minor to moderate in the near term and minor in the long term as impacts would not affect the overall health of the ecosystem. This alternative would be largely responsible for the adverse impacts.

Conclusion

Impacts to water quality, channel morphology, and aquatic species would be minor to moderate for up to four years after implementation begins. During this time, new construction and use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the streams and tributaries in the TUA. The extent of this ground surface and soil disturbance has the potential, through erosion, to generate sediments that can degrade aquatic habitats and the fish species that depend on them.

Impacts would be minor after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would be prohibited, monitoring degradation levels would mitigate damage, and impacts that did occur would be confined to where ORVs cross streams and tributaries. Use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species.

The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.6.6 Impacts to Water Resources Under Alternative 4

There would be no off-trail use of ORVs for subsistence or any other purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users

for all subsistence purposes *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail.

The analysis below shows that impacts to water quality, channel morphology, and aquatic species would be minor for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the few streams and tributaries in the TUA that are adjacent to the four trails that would be open to ORV use under this alternative. Impacts would be negligible after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would not occur, and monitoring degradation levels would mitigate damage.

More subsistence hunters would be expected to use the TUA than in the past because of the reasons listed in Alternative 1. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition. This means as many as 50 households could use ORVs on NPS-managed trails and routes to scope for moose, but ORVs would be permitted only on four trails and only from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons. This means that impacts to water resources would be confined to late summer and fall, and would only occur along the four open trails, so impacts would occur only streams and tributaries adjacent to those four trails. Because ORVs would not be crossing any streams or tributaries in the TUA off trail, there would be no impact to water resources in areas where there are no trails.

Closing off-trail areas to ORV use would encourage concentrated use along the Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail. For up to four years, impacts to water resources would occur wherever these trails cross clear-flowing streams or tributaries. In those areas, the types of impacts to water quality, channel morphology, and aquatic species would be similar to those described under Alternative 1. However, within four years, these trails and routes, including the sections of the Windy Creek Access Trail that are currently responsible for adding sediment to Windy Creek, would be maintained with the purpose of controlling erosion. Sediment-bearing water would be diverted off of trails so impacts to streams would be reduced. After implementation, stream capture, collection and drainage that would occur on trails under Alternative 1 would not occur in this alternative because the trails or trail sections that would be impacted in Alternative 1 would be either closed or improved to control erosion in this alternative.

Impacts would also be mitigated by managing access when necessary in response to conditions reaching warning or action degradation levels, which include evidence of persistent sedimentation immediately below an ORV soft-substrate stream crossing (warning level), and evidence of persistent sedimentation 20 meters or more below an ORV soft-substrate stream crossing (action level). This monitoring and action scheme would ensure impacts would not become major in any location.

Some additional soils damage could be realized by the method(s) chosen for alternative retrieval of harvested game, including use of horses. Horses can churn the soil strata, especially in sensitive soils, and thus make those soils vulnerable to erosion. However, under Alternative 4, horse traffic is expected only during the hunting season and in limited numbers.

There would be no impacts to water resources in the Bull River or Cantwell Creek because ORVs would not be permitted there.

The level of snowmachine use in the TUA would increase with a winter hunt. It is assumed that about 25 additional snowmachine groups may use the TUA for the winter hunt. Even with this increase, use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species. Snowmachines would not affect channel morphology because they travel above the surface of the stream.

Cumulative Impacts

In addition to the actions described in Alternative 1, it is foreseeable that NPS qualified subsistence users would use horses to pack out meat. As ORV use is restricted, more people would use horses, which can contribute fecal contaminants to streams and increase turbidity at crossings, but it is unlikely that they would have any profound impact on water resources.

Due to erosion in the TUA caused by past use of motorized vehicles and future horsepacking, these past and future actions would have a minor adverse impact on water resources in the TUA. The actions in this alternative would contribute minor adverse impacts due to ORVs crossing streams and tributaries in the TUA in the near term and negligible impacts in the long term. The cumulative impact of this alternative plus these past actions would be minor as impacts would not affect the overall health of the ecosystem. This alternative would be largely responsible for the adverse impacts.

Conclusion

Impacts to water quality, channel morphology, and aquatic species would be minor for up to four years after implementation begins. During this time, use of ORVs would negatively affect turbidity, bank stability, and aquatic species in a portion of the few streams and tributaries in the TUA that are adjacent to the four trails open to ORV use under this alternative. Impacts would be negligible after four years because water control, trail hardening, and other trail work would be completed. Cross-country use of ORVs would not occur, on-trail use would occur only in late summer and early fall, and monitoring degradation levels would mitigate damage. Use of snowmachines in the TUA would not be high enough to produce a measurable change in water quality parameters or health of aquatic species.

The level of impacts to water resources anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.7 VISITOR EXPERIENCE

4.7.1 Visitor Experience Impact Methodology

The impact analyses were based on consultation with subject matter experts, discussions with park users, and formal and informal comments from public meetings.

4.7.2 Impacts to Visitor Experience Under Alternative 1 (No Action)

The Cantwell TUA would remain open to the use of ORVs by NPS qualified subsistence users for subsistence purposes. ORV use for subsistence purposes would occur at anytime with any type of machine. More subsistence moose hunters would be expected to use the TUA than in the past, and we can assume the 50 households that hunt would go to the TUA first because:

a) The *2005 NPS Cantwell Subsistence Traditionally Employed ORV Determination* removed any ambiguity about whether ORV use for subsistence purposes is authorized in the TUA;
b) The TUA is right next to Cantwell;
c) Subsistence hunting in the TUA is unaffected by competition with non-local hunters (unlike on lands outside the TUA);
d) There would be continued improvements in the reliability of the ORVs themselves; and
e) The TUA is open earliest and latest for moose.

This means as many as 50 households could use ORVs to scope for moose throughout the TUA before and during hunting season. While ORVs could be used throughout the TUA, use would be concentrated along Cantwell Creek, Cantwell Airstrip Trail and the Windy Creek trails.

The analysis below shows impacts to visitor experience would be moderate because standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation could be approached or exceeded during the summer. These factors would degrade the quality of the park setting.

During summer and fall, most park visitors are hikers, cyclists, or NPS qualified subsistence users. Most park visitors travel through the TUA on the same ORV trails. Since ORV use is assumed to increase under this alternative, visitors would encounter more ORVs and greater impacts from ORVs, including evidence of modern human use, signs of social trails, campsites, or cut or broken vegetation. Visitors would experience frequent noise disturbance and encounters with others during August and September, when NPS qualified subsistence users use ORVs for subsistence purposes.

Visitors would also experience noise intrusions from administrative helicopter, airplane, and ORV use for monitoring purposes. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. It is assumed that this alternative would have the highest amount of administrative helicopter and ORV use. Experiencing frequent noise intrusions would degrade the park experience since one of the most important reasons people visit parks is to experience natural soundscapes (NPS 1995a).

Because of the above conditions, it is likely that Management Area B standards for frequency and intensity of noise intrusions; number of encounters with people; ability to camp out of sight and sound of others; evidence of modern human use; and signs of social trails, campsites, or cut or broken vegetation (see Section 3.3.5) would be approached or exceeded during August and September, and periodically throughout the summer. If the park believes that standards are being approached or exceeded, management action would be required to protect park resources and opportunities for quality visitor experiences.

Most parts of the TUA would remain difficult to access since there would be no trail improvements; visitors would continue to use unimproved ORV trails.

Winter visitors would not be affected by actions in this alternative.

Cumulative Impacts Analysis

The following past, present or reasonably foreseeable actions would affect visitor use in the TUA:

- The population of the State of Alaska has steadily grown for the last 30 to 40 years, and this trend is likely to continue. Park visitation is also likely to increase over the next 20 years. According to the U.S. Census, the Cantwell population has grown from 17 people in 1939 to 183 people when ANILCA was enacted in 1980 to 222 people in the latest census in 2000. The population is expected to continue increasing.
- Since 1980, new housing and commercial development has occurred around Cantwell. The gradual development spreading out from the Parks Highway corridor is likely to continue, creating increased interest in access to the eastern and southern boundaries of the national park, particularly the park additions.
- The National Park Service and its partners have assisted in promoting winter visitation in the park entrance area by hosting an annual Winterfest that began in 2001.
- Past motor vehicle use in the TUA has resulted in the loss of 14.8 ha (~37 acres) of vegetation.
- ANILCA allows snowmachines for subsistence, for traditional activities, and for travel to and from villages and homesites (ANILCA 811 and 1110). During the 1990s, technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali. Accurate estimates of snowmachine users are difficult to make, but during March and April of 1999, the NPS estimated that there were between 1,500 and 2,000 snowmobile users along the Parks Highway, primarily in the region from Cantwell to the West Fork of the Chulitna River and the Tokositna River area (NPS 2000a).

These actions show that there is potential for increased visitor demand in the TUA. Some of these actions would increase the frequency of noise intrusions in the TUA, thus degrading the quality of the visitor experience. Past and present use of snowmachines in winter and ORVs in summer and fall may have displaced non-motorized users, thereby creating a moderate to major cumulative impact. The actions proposed in this alternative would have a moderate negative effect on visitor experience due primarily to increased frequency of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation. The cumulative impact of this alternative plus these past, present, and future actions would be major. This alternative would be responsible for a majority of the adverse impacts, particularly during August and September when ORV use for subsistence would be highest and when administrative use of aircraft and ORVs would occur, and in the summer when helicopter use would occur.

Conclusion

This alternative would have moderate negative impacts to visitor experience because standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation could be approached or exceeded during the summer. These factors would degrade the quality of the park setting and would likely put this part of the park out of compliance with the zoning scheme described in the 2006 *Denali National Park and Preserve Backcountry Management Plan*.

The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.7.3 Impacts to Visitor Experience Under Alternative 2

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on NPS-managed trails and routes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). Both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes. During the summer and fall seasons, these trails and routes would be rezoned from Management Area B to Corridor (see 2006 *Denali National Park and Preserve Backcountry Management Plan* for a description of the Corridor zone).

The analysis below shows negative impacts to visitor experience would be minor to moderate because the standards for Management Area B and newly-imposed Corridors would be met, although the quality of the experience would be somewhat degraded by frequent noise intrusions and encounters with other people, modern equipment, and damaged vegetation.

ORV use would increase because more subsistence hunters would be expected to use the TUA than in the past due to the reasons listed under alternative 1, because the NPS-managed trails would be maintained/improved in better condition, and because the Bull River Access Trail would be constructed, facilitating access to the Bull River Floodplain. ORV use would be concentrated on NPS-managed trails, so visitors would experience noise from ORVs, have frequent encounters with other groups, and see ORV tracks, campsites, and cut or broken vegetation, particularly in August and September when ORV use for subsistence is greatest. Visitors would also experience the visual impact of new ORV trail construction, which could include a hardened trail surface and gravel borrow sites along the Bull River and Cantwell Creek. An increase in ORVs and evidence of their use would negatively impact the quality of the visitor experience.

Visitors would also experience noise intrusions under this alternative from administrative helicopter, airplane, and ORV use. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Experiencing frequent noise intrusions would degrade the visitor experience since one of the most important reasons people visit parks is to experience natural soundscapes (NPS 1995a).

Although the quality of the park setting would be somewhat degraded in summer and fall as described above, it would remain consistent with the Corridor Management Area standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation.

Access to the TUA would be enhanced for summer and fall users by improvements to the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail, and Upper Cantwell Creek and Bull River Floodplains.

Winter visitors would not be affected by actions in this alternative.

Cumulative Impacts Analysis

Cumulative impacts on visitor experience resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions show that there is potential for increased visitor demand in the TUA, that nonmotorized users may be displaced, and that some of these actions would increase the frequency of noise intrusions in the TUA, thus degrading the quality of the visitor experience. These cumulative actions create moderate to major negative impacts on visitor experience. The actions proposed in this alternative would have a minor to moderate negative effect on visitor experience due primarily to increased frequency of noise intrusions and other impacts from ORVs. The cumulative impact of this alternative plus these past, present, and future actions would be major. This alternative would be responsible for a substantial portion of the adverse impacts, particularly during August and September when ORV use for subsistence would be highest and when administrative use of aircraft and ORVs would occur, and in the summer when administrative helicopter, airplane, and ORV use would occur.

Conclusion

Negative impacts to visitor experience would be minor to moderate because the standards for Management Area B and newly-imposed Corridors would be met, although the quality of the experience would be somewhat degraded by frequent noise intrusions and encounters with other people, modern equipment, and damaged vegetation.

The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.7.4 Impacts to Visitor Experience Under Alternative 3

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). The Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes. During the summer and fall seasons, these trails and routes would be rezoned from Management Area B to Corridor (see 2006 *Denali National Park and Preserve Backcountry Management Plan* for a description of the Corridor zone).

The analysis below shows negative impacts to visitor experience would be minor to moderate because standards for the TUA could be approached or exceeded during winter, and the quality of the experience year-round would be somewhat degraded by increased frequency of noise

intrusions and increased potential of encountering other people, modern equipment, and campsites.

ORV use would increase because more subsistence hunters would be expected to use the TUA than in the past due to the reasons listed under alternative 1, because the NPS-managed trails would be maintained/improved in better condition, and because the Bull River Access Trail would be constructed, facilitating access to the Bull River Floodplain. ORV use would be concentrated on NPS-managed trails, so visitors would experience noise from ORVs, have frequent encounters with other groups, and see ORV tracks, campsites, and cut or broken vegetation, particularly in August and September when ORV use for subsistence is greatest. Visitors would also experience the visual impact of new ORV trail construction, which could include a hardened trail surface and gravel borrow sites along the Bull River and Cantwell Creek. An increase in ORVs and evidence of their use would negatively impact the quality of the visitor experience.

Visitors would also experience noise intrusions under this alternative from administrative helicopter, airplane, and ORV use. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes.

Although the quality of the park setting would be somewhat degraded in summer and fall as described above, it would remain consistent with the Corridor Management Area standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation.

Access to the TUA would be enhanced for summer and fall visitors by improvements to the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, Cantwell Airstrip Trail, Bull River Access Trail, and Cantwell Creek and Bull River Floodplains.

If a winter hunt was instituted, snowmachines would travel throughout the TUA during the expanded winter moose hunting season. Assuming about 50 households in Cantwell say they try to hunt moose, and further assuming about half are successful in the summer, then the remaining 25 households would likely take advantage of the expanded winter moose hunt. This means about 25 additional snowmachine groups may use the traditional use area for the winter hunt. A winter hunt would introduce additional noise, encounters with others, and encounters with modern human equipment from snowmachine use in the TUA. Experiencing frequent noise intrusions would degrade the experience since one of the most important reasons people visit parks is to experience natural soundscapes (NPS 1995a). While the impact might be noticeable, the majority of snowmachine use and corresponding impacts would be from existing use. It is possible that standards for Management Area B for noise, modern equipment, and encounters could be approached or exceeded in the TUA during winter, putting this part of the park out of compliance with the zoning scheme described in the 2006 *Denali National Park and Preserve Backcountry Management Plan*.

Cumulative Impacts

Cumulative impacts on visitor experience resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions show that there is potential for increased visitor demand in the TUA, that nonmotorized users may be displaced, and that some of these actions would increase the frequency of noise intrusions in the TUA, thus degrading the quality of the visitor experience. These cumulative actions create moderate to major negative impacts on visitor experience. The actions proposed in this alternative would have a minor to moderate negative effect on visitor experience due primarily to increased frequency of noise intrusions during summer, fall, and winter. The cumulative impact of this alternative plus these past, present, and future actions would be major. This alternative would be responsible for a substantial portion of the adverse impacts as noise intrusions would be introduced nearly year-round, and zoning standards could be approached or exceeded during winter.

Conclusion

Impacts to visitor experience would be minor to moderate because standards for the TUA could be approached or exceeded during winter, and the quality of the experience year-round would be somewhat degraded by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites.

The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.7.5 Impacts to Visitor Experience Under Alternative 4

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail. During the summer and fall seasons, these trails would be rezoned from Management Area B to Corridor.

The analysis below shows impacts to visitor experience would be minor because standards for the TUA could be approached or exceeded during winter, and the quality of the experience would be somewhat degraded during fall by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites. The quality of the summer visitor experience would be improved by eliminating impacts from ORVs from the TUA during summer.

ORV use would increase because more subsistence hunters would be expected to use the TUA than in the past due to the reasons listed under alternative 1, and because the NPS-managed trails would be maintained/improved in better condition. ORV use would be concentrated on NPS-managed trails, so visitors would experience noise from ORVs, have frequent encounters with other groups, and see ORV tracks, campsites, and cut or broken vegetation. While evidence of use such as campsites or cut vegetation could be seen throughout summer, ORVs would be permitted only from one week before the beginning of the fall moose and caribou hunting seasons

through to the end of these hunting seasons. So while the park visitor would expect to encounter ORVs when they are permitted, they would not encounter ORVs during most of the summer.

Visitors would also experience noise intrusions under this alternative from administrative helicopter, airplane, and ORV use. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes.

Although the quality of the park setting would be somewhat degraded in summer and fall as described above, it would remain consistent with the Corridor Management Area standards for frequency and intensity of noise intrusions, number of encounters with people, evidence of modern human use, and signs of social trails, campsites, or cut or broken vegetation.

Access to the TUA would be enhanced for summer and fall visitors by improvements to the Windy Creek Access Trail, Windy Creek Bowl Trail, Pyramid Creek Trail, and Cantwell Airstrip Trail.

If a winter hunt was instituted, snowmachines would travel throughout the TUA during the expanded winter moose hunting season. Assuming about 50 households in Cantwell say they try to hunt moose, and further assuming about half are successful in the summer, then the remaining 25 households would likely take advantage of the expanded winter moose hunt. This means about 25 additional snowmachine groups may use the traditional use area for the winter hunt. A winter hunt would introduce additional noise, encounters with others, and encounters with modern human equipment from snowmachine use in the TUA. Experiencing frequent noise intrusions would degrade the experience since one of the most important reasons people visit parks is to experience natural soundscapes (NPS 1995a). While the impact might be noticeable, the majority of snowmachine use and corresponding impacts would be from existing use. It is possible that standards for Management Area B for noise, modern equipment, and encounters could be approached or exceeded in the TUA during winter, putting this part of the park out of compliance with the zoning scheme described in the 2006 *Denali National Park and Preserve Backcountry Management Plan*.

Cumulative Impacts

Cumulative impacts on visitor experience resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions show that there is potential for increased visitor demand in the TUA, that nonmotorized users may be displaced, and that some of these actions would increase the frequency of noise intrusions in the TUA, thus degrading the quality of the visitor experience. These cumulative actions create moderate to major negative impacts on visitor experience. The actions proposed in this alternative would have a minor negative effect on visitor experience due primarily to increased frequency of noise intrusions primarily during fall. The cumulative impact of this alternative plus these past, present, and future actions would be moderate to major. This alternative would be responsible for a noticeable portion of the adverse impacts as noise intrusions would be introduced and zoning standards could be approached or exceeded during winter.

Conclusion

Impacts to visitor experience would be minor because standards for the TUA could be approached or exceeded during winter, and the quality of the experience would be somewhat degraded during fall by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites. The quality of the summer visitor experience would be improved by eliminating impacts from ORVs from the TUA during summer.

The level of impacts to visitor experience anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.8 WILDERNESS

ANILCA provides some exceptions to standard national park and wilderness management practices, including allowing the appropriate use of certain motorized means of surface transportation traditionally employed for subsistence purposes. The analysis in this section acknowledges that ORV use for subsistence purposes can be permitted in wilderness just like many other activities. However, all permitted activities, including those related to subsistence, are subject to evaluation and management. For example, hiking is also a permitted activity in wilderness, but the damage sometimes created by it, particularly the development of networks of social trails, is commonly found to be damaging to wilderness values, and is regulated as a result to confine or mitigate the impacts. Even in the special context of ANILCA, a permitted activity or use may cause major impacts or even impairment and can therefore become inappropriate or incompatible with wilderness or other resource values.

4.8.1 Wilderness Impact Methodology

The impact analyses are based on consultation with subject matter experts, discussions with park users, and formal and informal comments from public meetings.

4.8.2 General Wilderness Impacts

Direct impacts on natural conditions as expressed by changes in wildlife, soundscapes, and other natural resources are addressed in other sections of this document. The analysis in this section would focus on the dependence of wilderness character and wilderness experience on the presence of natural conditions and the lack of signs of modern human activity. A specific concern is the degree to which different forms of impact related to ORV use influence the perception that that human presence is altering natural condition. This includes the trails that are produced by ORVs and the presence of ORVs themselves. The physical, biological, and visual impacts that ORV trails create are all an indication of prior human use of the area. They are distinctly different than trail impacts from wildlife because they clearly represent assistance from devices of modern civilization. For the purpose of this analysis, the occurrence of networks of ORV trails would be considered a direct impact to wilderness character because they are an obvious reminder of modern human presence and mechanization.

4.8.3 Impacts to Wilderness Under Alternative 1 (No Action)

The actions in this alternative would result in adverse impacts to wilderness resource values within the TUA primarily from the cross country ORV use that would continue to occur throughout much of the area. As described in Impacts to Visitor Experience, park users would experience frequent noise disturbance, encounters with others, evidence of modern human use, signs of social trails, campsites, or cut or broken vegetation. Wilderness resource values such as the presence of natural conditions and solitude would be compromised by the extensive presence of ORVs in the area and the trail damage they would create. The continuation of dispersed ORV use and the resultant adverse impacts would necessitate the re-designation of the current status of the TUA from eligible for wilderness designation to ineligible.

Presence of natural conditions

The use of ORVs away from established trail corridors in the TUA would lead to the development of numerous additional trail impacts across the TUA. These impacts would be essentially permanent in nature due to the degree of damage to soils. They would develop in all habitats in the TUA rather than being confined to a limited number of narrow corridors. The linear nature and width of these trail impacts would be distinctly different from natural disturbances in the area. New trail formation would substantially alter the natural landscape and diminish its eligibility for wilderness designation.

Absence of Permanent Structures

There would be no effect, either positive or negative, to this aspect of wilderness resource values since no new permanent structures are proposed to be added or removed under this alternative.

Solitude and Reminders of Modern Human Use

As noted in Section 3.6 (Wilderness Affected Environment), one of the essential wilderness resource values, opportunities for solitude, is defined in part by freedom from the reminders of society and the absence of mechanization and signs of modern human presence. Increased levels of ORV use and few restrictions on that use would result in sustained and additional trail formation throughout the TUA. It would also result in intensification of damage along existing trails. These networks of user-created trails would negatively impact wilderness resource values by contributing reminders of modern human use throughout the TUA.

Cumulative Impacts

The following past, present or reasonably foreseeable actions would affect wilderness resource values in the TUA:

- The population of the State of Alaska has steadily grown for the last 30 to 40 years, and this trend is likely to continue. Park visitation is also likely to increase over the next 20 years. According to the U.S. Census, the Cantwell population has grown from 17 people in 1939 to 183 people when ANILCA was enacted in 1980 to 222 people in the latest census in 2000. The population is expected to continue increasing.
- Since 1980, new housing and commercial development has occurred around Cantwell. The gradual development spreading out from the Parks Highway corridor is likely to continue,

creating increased interest in access to the eastern and southern boundaries of the national park, particularly the park additions.
- Past motor vehicle use in the TUA has resulted in the loss of 14.8 ha (~37 acres) of vegetation.
- ANILCA allows snowmachines for subsistence, for traditional activities, and for travel to and from villages and homesites (ANILCA 811 and 1110). During the 1990s, technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali. Accurate estimates of snowmachine users are difficult to make, but during March and April of 1999, the NPS estimated that there were between 1,500 and 2,000 snowmobile users along the Parks Highway, primarily in the region from Cantwell to the West Fork of the Chulitna River and the Tokositna River area (NPS 2000a).

These actions contribute a moderate negative impact to wilderness resource values due to impacts from past and future visitor use, especially motor vehicle use, and from a potential increased demand for use of the TUA. The actions proposed in this alternative would have a major negative effect on wilderness resource values due primarily to expansion of many miles of new ORV trails throughout the TUA. The cumulative impact of this alternative plus these past, present, and future actions would be major. This alternative would be responsible for a majority of the adverse impacts as this alternative would compromise the wilderness eligibility of the TUA.

Conclusion

Alternative 1 would cause major adverse impacts on wilderness resources because the lack of proactive management would result in two important wilderness resource values, presence of natural conditions and opportunities for solitude, being compromised by the perpetuation of existing damage and the expansion of many miles of new ORV trails throughout the TUA. The level of these adverse impacts would necessitate the re-designation of the current status of the TUA from eligible for wilderness designation to one of ineligible.

The level of impacts to wilderness resource values anticipated from this alternative would result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.8.4 Impacts to Wilderness Under Alternative 2

Alternative 2 would result in major adverse impacts to wilderness resource values primarily from the continuation of dispersed ORV use and its displacement into new habitats and areas of the TUA. New trail impacts that would persist over a number of seasons are likely to be created under this alternative because of the number of retrievals every year combined with the limited amount of terrain and reasonable travel routes that are available to disperse this use, and the characteristics of the vegetation in areas where retrieval trips would take place. The trail formation would also shift to new locations and habitats by the closure of some previously impacted areas and the construction of a new trail into the Bull River drainage. Additionally, as described in Impacts to Visitor Experience, the quality of the visitor experience would be somewhat degraded by frequent noise intrusions and encounters with other people, modern equipment, and damaged vegetation.

Stipulations for off-trail ORV use under this alternative may slow the rate of new trail development. The closures would create some improvements over current conditions by allowing damaged areas to recover or prohibiting ORV use on saturated soils. However, positive effects

from these restrictions are likely to be offset by facilitating ORV use into the Bull River drainage and shifting use onto currently undisturbed travel corridors adjacent to the closed areas. Over time there would be a net expansion of visible trail impacts across the TUA, as described in Impacts to Vegetation under Alternative 2. As a result, there is a high probability that in the future additional management actions would be required. The continuation of dispersed ORV use and the resultant adverse impacts could necessitate the re-designation of the current status of the TUA from eligible for wilderness designation to one of ineligible.

Presence of Natural Conditions

Cross-country use of ORVs would lead to the development of numerous additional trail impacts. The net effect of this alternative would be to shift use and the resulting trail impacts into new environments. The linear nature and width of these trail impacts would be distinctly different from natural disturbances in the area. These new user formed trails would continue to alter the natural landscape.

Absence of Permanent Structures

The presence of permanent structures in the area would increase due to the development of three new trails or routes and the incorporation of several other existing trails into a network of permanently maintained trails.

Solitude and Reminders of Modern Human Use

Increased levels of ORV use and cross country travel, and the subsequent impacts to vegetation and soils, would serve as reminders of modern human use and mechanization in many parts of the TUA. The development of a new trail into the Bull River would facilitate ORV access into that area and reduce the opportunities for solitude that currently exist in that portion of the TUA. All areas and trails closed for recovery would be posted with closure signs, and barriers would be placed at the start of the closed trail sections. These modern conveyances would also serve as reminders of modern human use and detract from the natural setting of the area. Evidence of human use would be reduced by the maintenance of the existing trails that are retained because a sustainable trail does not appear to be heavily used the way an unsustainable trail, with mud holes, rutting, and braids, might give the impression of heavy or abusive use.

Cumulative Impacts

Cumulative impacts on wilderness resource values resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions contribute a moderate negative impact to wilderness resource values due to impacts from past and future visitor use, especially motor vehicle use, and from a potential increased demand for use of the TUA. The actions proposed in this alternative would have a major negative effect on wilderness resource values due primarily to expansion of many miles of new ORV trails throughout the TUA. The cumulative impact of this alternative plus these past, present, and future actions would be major. This alternative would be responsible for a majority of the adverse impacts as this alternative could compromise the wilderness eligibility of the TUA.

Conclusion

Alternative 2 would result in major negative impacts to wilderness resource values within the TUA because dispersed cross country ORV use would occur throughout much of the area. Two

important wilderness resource values, presence of natural conditions and opportunities for solitude, would be compromised by the perpetuation and expansion of several miles of user formed ORV trails. New trail construction would increase the presence of permanent human structures in the area.

The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.8.5 Impacts to Wilderness Under Alternative 3

The actions in this alternative would result in moderate adverse impacts to wilderness resource values. As described in Impacts to Visitor Experience, the quality of the experience would be somewhat degraded by increased frequency of noise intrusions and increased potential of encountering other people, modern equipment, and campsites. Most of the impact under this alternative would be caused by the development of a new maintained trail into the Bull River, and maintained routes or trails to both the Bull River and Upper Cantwell Creek Floodplains. New maintained trails would result in increased ORV use in these areas. Impacts associated with these trails would be somewhat mitigated by the restriction of ORV use to designated trail corridors which would allow the damage from past incursions to recover. Confining use to limited locations could retain the wilderness eligibility status for the TUA.

Presence of Natural Conditions

Developing new maintained trails into the Bull River and Cantwell Creek drainages would negatively impact natural conditions by facilitating ORV use of these areas. The presence of ORVs and their associated impacts would increase, which would degrade natural conditions.

On the other hand, restricting ORV use to identified trails would allow previously damaged cross country areas to recover. This action would help restore natural conditions.

The visual trail impacts from horsepacking for retrieval would be minor given the expected low level of use. Trails created by horses would be similar in character to animal trails from moose and caribou that are prevalent in the TUA, so they would appear more natural than tracks left by ORVs.

Absence of Permanent Structures

There would be an increase in the presence of permanent structures due to the development of three new trails or routes and the incorporation of several other existing trails into a network of permanently maintained trails.

Solitude and Reminders of Modern Human Use

The lack of dispersed ORV use would ensure that the visual footprint of human presence in the TUA is restricted solely to the identified trails. Confining the use of ORVs to trails would also keep motorized noise impacts within a localized areas rather than spreading the noise over the entire area. The combination of these changes would increase opportunities for solitude within the TUA.

Evidence of human use would be reduced by the maintenance of the existing trails that are retained because a sustainable trail does not appear to be heavily used the way an unsustainable trail, with mud holes, rutting, and braids, might give the impression of heavy or abusive use.

These beneficial changes would be somewhat offset by impacts from increased levels of ORV use anticipated from this alternative. Opportunities for solitude would be reduced on trails in the TUA since ORV use would be concentrated on these same trails and routes. Also, all areas and trails closed for recovery would be posted with closure signs, and barriers would be placed at the start of the closed trail sections. These modern conveyances would also serve as reminders of modern human use and detract from the natural setting of the area.

A winter hunt would contribute additional snowmachine use to the TUA. It would be expected to involve about 25 additional snowmachine groups. Opportunities for solitude in the TUA during winter would not be noticeably affected given the current level of snowmachine use that is already occurring in the area.

Cumulative Impacts

Cumulative impacts on wilderness resource values resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions contribute a moderate negative impact to wilderness resource values due to impacts from past and future visitor use, especially motor vehicle use, and from a potential increased demand for use of the TUA. The actions proposed in this alternative would have moderate negative impacts on wilderness resource values due primarily to new trail development. The cumulative impact of this alternative plus these past, present, and future actions would be moderate. This alternative would be responsible for a substantial portion of the adverse impacts.

Conclusion

Alternative 3 would result in moderate negative impacts to wilderness resource values. ORV use in areas such as the Bull River would increase. New trail development and designation of existing trails would add to the presence of permanent human structures in the area. These impacts would be somewhat offset by the recovery of currently impacted areas. Maintenance of trails would also reduce their obtrusiveness. Confining ORV use to trails or routes, and allowing damaged areas to recover, would retain eligibility for wilderness designation status for the TUA.

The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.8.6 Impacts to Wilderness Under Alternative 4

This alternative would result in moderate benefits to wilderness resource values due largely to the mitigation of past ORV impacts that have compromised the eligibility of the area for designation as wilderness. All ORV use would be confined to the trail corridors that were present at the time of the eligibility determination in 1986. This would allow recovery of off-trail areas. Restoring and maintaining trails would also benefit wilderness resource values by restoring damaged areas and reducing signs of motorized use.

As described in Impacts to Visitor Experience, the quality of the experience would be somewhat degraded during fall by increased frequency of noise intrusions and increased potential of

encountering other people. The experience would be improved during summer due to decreased noise from ORVs.

Presence of Natural Conditions

Natural conditions would be restored by allowing existing ORV impacts to recover. The trails that would be maintained for continued use would negatively affect natural conditions but are consistent with the footprint of impact that was considered to be acceptable in the context of the wilderness eligibility determination in 1986 for the TUA area.

The visual trail impacts from horsepacking for retrieval would be minor given the expected low level of use. Trails created by horses would be similar in character to animal trails from moose and caribou that are prevalent in the TUA, so they would appear more natural than tracks left by ORVs.

Absence of Permanent Structures

There would be a minor negative impact from permanent human structures due to the establishment of a permanently maintained trail system.

Solitude and Reminders of Modern Human Use

There would be continued presence of ORVs traveling on trails in the TUA; however, eliminating dispersed ORV use would reduce the visual footprint of human presence in the TUA and the area where ORVs could be encountered.

Evidence of human use would be reduced by the maintenance of the existing trails that are retained because a sustainable trail does not appear to be heavily used the way an unsustainable trail, with mud holes, rutting, and braids, might give the impression of heavy or abusive use.

A winter hunt would contribute additional snowmachine use to the TUA. It would be expected to involve about 25 additional snowmachine groups. Opportunities for solitude in the TUA during winter would not be noticeably affected given the current level of snowmachine use that is already occurring in the area.

Cumulative Impacts

Cumulative impacts on wilderness resource values resulting from past, present, and reasonably foreseeable future actions are the same as Alternative 1. These actions contribute a moderate negative impact to wilderness resource values due to impacts from past and future visitor use, especially motor vehicle use, and from a potential increased demand for use of the TUA. The actions proposed in this alternative would have a moderate positive effect on wilderness resource values due primarily to the elimination of ORV trails, routes, and dispersed ORV travel. The cumulative impact of this alternative plus these past, present, and future actions would be negligible. This alternative would be responsible for a majority of the positive impacts.

Conclusion

The actions in this alternative would result in overall moderate benefits to wilderness resource values, largely due to the elimination of ORV trails, routes, and dispersed ORV travel. There would be major improvements to the presence of natural conditions and solitude due to the

recovery of large areas of impact and a reduced scope of motorized use. Minor impacts to both of these values as well as the absence of human structures would remain as a result of the established system of trails. Impacts from horsepacking or the winter hunt would be negligible. This alternative would be fully consistent with the current eligibility determination for the area.

The level of impacts to wilderness resource values anticipated from this alternative would not result in an impairment of park resources that fulfill specific purposes identified in the establishing legislation or that are key to the integrity of the park.

4.9 SUBSISTENCE OPPORTUNITIES

4.9.1 Subsistence Opportunities Impacts Methodology

The principal method for the impact analysis involved a review of published and unpublished literature, such at the *Denali National Park and Preserve Subsistence Management Plan*, and other materials regarding the effects of management activities on access and on wildlife mortality and disturbance. In addition to literature review, the impact analyses were based on consultation with subject matter experts, discussions with NPS qualified subsistence users, and formal and informal comments from public meetings.

4.9.2 General Impacts to Subsistence Opportunities

Impacts to subsistence include restricting access to subsistence resources, limiting the availability of subsistence resources, and increasing competition for subsistence resources. Availability of resources can vary under different management options. Different types of access options can affect the level of effort required, time involved, and the effectiveness of the hunt. Competition would increase or decrease depending on the management action. These items can negatively affect the subsistence user by making subsistence activities more difficult and time-consuming, limiting the amount of food or supplies the subsistence user can obtain, and altering the subsistence user's traditional way of life and quality of life.

4.9.3 Impacts to Subsistence Opportunities Under Alternative 1 (No Action)

Alternative 1 would result in major negative effects to subsistence moose resources and opportunities. There would initially be greater access to subsistence moose resources and improved opportunities because of the opening of the TUA to ORV use. While this would lead to easier hunting, it would eventually result in more pressure on moose populations and increased harvest and competition among hunters. Over the long term the lack of proactive management would mean that moose harvests, facilitated by easy ORV access, would be above the sustainable level and require hunting outside the TUA.

Subsistence resources

As explained in the impacts to wildlife section (see Section 4.6.3), Alternative 1 would have a major adverse impact on moose in the Cantwell TUA because levels of harvest would increase dramatically over the current average of 5 moose per year. Moose harvests would initially increase; then the population may become depleted as there is not a large enough bull moose population to sustain an annual taking of 10 moose.

While the initial increased moose harvest would benefit subsistence hunters, within a few years the hunting pressure would likely remove or displace moose in important hunting areas, reducing the number of moose that could be harvested from the TUA in general. This lower harvest level would mean that NPS qualified subsistence users would have to expend more time and effort hunting outside the TUA. Because of increased pressure on resources and increased competition outside the TUA, hunting outside the TUA would not guarantee success for subsistence hunters.

Access

Under Alternative 1, both on-trail and off-trail ORV use would be allowed for all subsistence purposes by NPS qualified subsistence users throughout the TUA. People would use ORVs primarily in August and September, anywhere in the TUA, with any type of machine. NPS qualified subsistence users would continue to drive ORVs throughout the TUA in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 1 would provide complete access to both the lower drainages and the head waters because of the lack of restrictions on ORVs. The effect is that under this alternative a subsistence hunter could travel throughout the TUA by ORV for scouting, hunting, and game retrieval, improving their chances of a successful hunt. However, the number of moose harvested would continue to depend on where the moose were in any given year.

In this alternative, improvements to existing ORV trails would not be made, so while access would be very open, the condition of the ORV trails would continue to deteriorate.

Competition among NPS qualified subsistence users

Alternative 1 would result in increased competition among NPS qualified subsistence users because more subsistence moose hunters would be expected to use the TUA, greater access, and subsequent decrease in availability of moose. In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season. The effect of these factors is that there would be an immediate increase in competition for limited numbers of moose.

Way of Life

Subsistence use would continue to provide a considerable proportion of the rural diet; however, the amount of moose meat in subsistence users' diets would decrease in the long term proportionate to the decrease in moose in the TUA. As the opportunity to hunt diminishes with a decrease in availability of moose in the TUA, successful hunts would be less likely and residents would have to supplement their diets. The opportunity for children to learn from elders to identify resources, methods of harvest, and efficient and non-wasteful processing and preparation of moose would decrease over time because of the loss of resources. The amount of time and effort required for a successful moose hunt would be shortened in the short term, but in the long term a hunt would require a lot more time and effort because there would be fewer moose available to hunt. There would be no displacement of less-mobile users because ORVs would be allowed throughout the TUA.

Economic Analysis

The economic analysis can be determined based on the effect of each alternative on the total annual number of moose harvested by Cantwell subsistence hunters both inside and outside the TUA. Competition for subsistence moose hunting opportunities on general State lands within GMU 13E is increasing, and Cantwell residents have started shifting their hunting effort towards park lands (park lands in Unit 13E Cantwell area and in Unit 20C Kantishna Hills). This trend would continue and subsistence hunters could depend on hunting on park lands for more than half of the moose the Cantwell community needs in the future (Callaway 2006). In 1999, 27 moose were harvested by the Cantwell community from State and park lands (ADFG 2002). Using this number as a baseline for how many moose harvests would continue to be needed by the community, then 13-14 of those moose would have to come from park lands in the future.

We assume that moose harvests would initially double to 10 (see Impacts to Wildlife), providing most of the 13-14 moose needed from the TUA; then they would decrease considerably because moose populations would be depleted. For this exercise, we assume that in the long term 1-2 moose would be harvested annually from the TUA. Therefore, subsistence hunters could have to turn to *other* park lands in 13E and 20C to find the remaining 11-13 moose they need. At most, if those 11-13 moose couldn't be harvested, it would be a loss of 11-13 moose for the community per year. If a dressed moose weighs 1,000 pounds, this is a loss of 11,000-13,000 pounds of moose meat to the community per year. At a market basket estimate of $8/lb, this would be a shortfall in dollars of nearly $88,000 to $104,000 – or a loss of $880 to $1,040 per household (assuming 100 subsistence households in Cantwell residence zone).

Though income levels in Cantwell may fluctuate from year to year, the median family income for Cantwell for 2000 was $39,792 (U.S. Census 2000). An economic loss of $880 to $1,040 for a family would be a loss of 2.2% – 2.6% of their annual income.

Cumulative Impacts

The following past, present, or reasonably foreseeable actions would affect subsistence use in the TUA:

- The population of the State of Alaska has steadily grown for the last 30 to 40 years, and this trend is likely to continue. Park visitation is also likely to increase over the next 20 years. According to the U.S. Census, the Cantwell population has grown from 17 people in 1939 to 183 people when ANILCA was enacted in 1980 to 222 people in the latest census in 2000. The population is expected to continue increasing.
- The overall number of hunters on general State lands within GMU 13E is increasing. This, combined with tightening of regulations for hunting on these State lands, increases the competition for subsistence opportunities.
- ORV use has been unlimited on State land adjacent to the TUA, and ORVs are likely to continue to be allowed on these lands in the future.

Increases in the Cantwell population and increases in the overall number of hunters would continue to increase competition in the TUA. These past, present, and future actions would have a moderate adverse impact on subsistence use in the TUA. This alternative would be responsible for a substantial portion of the adverse impacts because of the proximity and importance of the TUA to Cantwell NPS qualified subsistence users. The cumulative adverse impact of this alternative plus these past, present, and future actions would therefore be major.

Conclusion

Actions in this alternative would have major negative impacts because subsistence moose hunting, facilitated by unrestricted ORV access, would be above a sustainable level in the TUA. Over the long term NPS qualified subsistence users would have to expend more time and effort hunting moose on non-park lands and could be affected by increasing restrictions as well as declining wildlife populations on those lands.

The level of impacts to subsistence anticipated from this alternative would eventually result in a significant restriction to subsistence resources (moose).

4.9.4 Impacts to Subsistence Opportunities Under Alternative 2

Alternative 2 would result in minor beneficial effects to subsistence resources and opportunities because of extensive ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Enhanced access to subsistence resources and opportunities would result from identifying trails and routes for ORV use and the provision for ORV access for moose and caribou retrieval. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term. The identified ORV trails and routes would be in good moose habitat, so for much of the subsistence hunting season (the last half of August and the month of September) there would be more opportunities to hunt moose near trails. Counteracting these benefits, however, would be the restrictions on ORV use for retrieval and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term.

Subsistence resources

As explained in Section 4.6.4, Impacts to Wildlife under Alternative 2, actions proposed in this alternative would have a moderate adverse impact on wildlife in the TUA because the number of moose harvested each year could increase above the current average of 5 moose/year. Noise from helicopters, airplanes, and ORVs would disturb wildlife. These factors would result in adverse impacts to the availability of subsistence resources (particularly moose). However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. The harvest limit would counteract the potential threat of over-harvest and decreased resource availability, thus providing a benefit to subsistence hunters.

Access

Under this alternative, off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on NPS-managed trails and routes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). Both the Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

Construction of the Bull River Access Trail would open more territory (the Bull River Floodplain) to subsistence hunters and the NPS-managed trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

Access patterns under Alternative 2 would include use of ORVs primarily in August and September along the NPS-managed trails and routes. NPS qualified subsistence users would drive ORVs in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 2 would provide access to all of the important lower drainages. The number of moose harvested would continue to depend on where the moose were in any given year.

Alternative 2 would also provide the option of using ORVs for retrieval of harvested moose and caribou, although closures within the TUA may limit any large-scale benefits of this. Management actions would make it more difficult to use an ORV to retrieve a moose far from an NPS-managed trail or route than is currently the case. As a result, subsistence hunters would likely spend more time looking for moose closer to the trails, and off-trail areas could get very little use. However, some hunters would still harvest these animals off-trail even if they could not use an ORV to retrieve them.

The overall effect would be that under this alternative a hunter would realize some limiting factors on access to subsistence hunting while benefiting from improved trails, a new Bull River Access Trail, and improved access to the Bull River and Upper Cantwell Creek Floodplains.

Competition among NPS qualified subsistence users

As under Alternative 1, Alternative 2 would result in increased competition among NPS qualified subsistence users because more subsistence hunters would be expected to use the TUA than in the past, and because use would be focused on a finite number of NPS-managed trails and routes.

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

These factors would result in increased competition for subsistence resources. Increased competition is likely to continue over the long term because the NPS-managed trails and routes are in the most important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits). This could result in a return to state lands by a small minority of the hunters. Those hunters who harvest game farther from identified trails and routes would benefit from less competition.

Way of Life

Subsistence use would continue to provide a considerable proportion of the rural diet during the life of this plan because the NPS would manage park uses in order to protect natural and healthy wildlife populations. The opportunity for children to learn from elders to identify resources, methods of harvest, and efficient and non-wasteful processing and preparation of moose would continue as it has in the past. While management for sustainable use would protect these subsistence values, successful moose hunts would require more time and effort because of the restrictions on off-trail use of ORVs. There would be no displacement of less-mobile users

because ORVs would be allowed throughout the TUA. Since ORVs would still be allowed off-trail, less-mobile users would generally not be displaced, though they, like everyone else, may prefer to focus on NPS-managed trails instead of dealing with off-trail restrictions.

Economic Analysis

The economic analysis can be determined based on the effect of each alternative on the total annual number of moose harvested by Cantwell subsistence hunters both inside and outside the TUA. Competition for subsistence moose hunting opportunities on general State lands within GMU 13E is increasing, and Cantwell residents have started shifting their hunting effort towards park lands (park lands in Unit 13E Cantwell area and in Unit 20C Kantishna Hills). Given the continuation of this trend, subsistence hunters could depend on hunting on park lands for more than half of the moose the Cantwell community needs in the future (Callaway 2006). In 1999, 27 moose were harvested by the Cantwell community from State and park lands (ADFG 2002). Using this number as a baseline for how many moose harvests would continue to be needed by the community, then 13-14 of those moose would have to come from park lands in the future.

We assume the TUA can't support a harvest of 13-14 moose/year (see Alternative 1 assumptions), but it can support an average of 5 moose harvested from the TUA (or slightly more up to some harvest limit). For this exercise we assume that the limit would be 5 moose. Therefore, subsistence hunters could have to turn to *other* park lands in 13E and 20C to find the remaining 8-9 moose they need. At most, if those 8-9 moose couldn't be harvested, it would be a loss of 8-9 moose for the community per year. If a dressed moose weighs 1,000 pounds, this is a loss of 8,000-9,000 pounds of moose meat to the community per year. At a market basket estimate of $8/lb, this would be a shortfall in dollars of nearly $64,000 to $72,000 – or a loss of $640 to $720 per household (assuming 100 subsistence households in Cantwell residence zone).

Though income levels in Cantwell may fluctuate from year to year, the median family income for Cantwell for 2000 was $39,792 (U.S. Census 2000). An economic loss of $640 to $720 for a family would be a loss of 1.6% – 1.8% of their annual income.

Cumulative Impacts

Cumulative impacts on subsistence use resulting from past, present, and reasonably foreseeable future actions are the same as under Alternative 1. Increases in the Cantwell population and increases in the overall number of hunters would continue to increase competition in the TUA. Because of the impacts to subsistence resources and due to the increased competition for hunting in general, these past, present, and future actions would have a moderate adverse impact on subsistence use in the TUA. The actions in Alternative 2 would counteract these effects to some extent because of extensive ORV access and proactive wildlife management. The cumulative adverse impact of this alternative plus these past, present, and future actions would therefore be minor.

Conclusion

Alternative 2 would result in minor beneficial effects to subsistence resources and opportunities because of extensive ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Enhanced access to subsistence resources and opportunities would result from identifying and maintaining trails and routes for ORV use and the provision for ORV access for moose and caribou retrieval. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for

moose and caribou, would make it possible to have a sustainable harvest level over the long term. The identified ORV trails and routes would be in good moose habitat, so for much of the subsistence hunting season (the last half of August and the month of September) there would be improved opportunities to hunt moose near trails. Counteracting these benefits, however, would be the restrictions on ORV use for retrieval and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term.

The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.

4.9.5 Impacts to Subsistence Opportunities Under Alternative 3

Alternative 3 would result in minor beneficial impacts to subsistence resources and opportunities because of improved access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Greater access to subsistence resources and opportunities would result from improvements to NPS-managed trails and routes, and new access to the Bull River Floodplain. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term and remove uncertainty for NPS qualified subsistence users. The identified ORV trails and routes would be in good moose habitat, so harvests would be likely to increase. There would also be a winter hunt extending as long as possible, which if established would provide additional subsistence opportunities. Counteracting these benefits, however, would be restrictions on off-trail ORV use and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term.

Subsistence resources

Moose harvests in the TUA would at least continue to average 5 moose harvested/year (based on past 15-year average) or could increase up to set harvest limit levels because of the reasons explained in Section 4.6.5, Impacts to Wildlife from Alternative 3. Due to increased mortality, actions proposed in this alternative would have a moderate adverse impact on wildlife, particularly moose and wolves. Noise from helicopters, airplanes, ORVs, and snowmachines would disturb wildlife. These factors would result in adverse impacts to the availability of subsistence resources (particularly moose and wolves). However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. This alternative also proposes that the NPS monitor the number of wolf harvests and, if necessary, a limit would be proposed to maintain natural and healthy wolf populations.

Since ORVs would be restricted to NPS-managed trails for scouting game, it is likely that more moose would be harvested closer to trails, assuming moose have come down from the headwaters. Greater numbers of moose harvested near trails could affect local moose populations along the Cantwell Creek, Windy Creek, and Bull River Access Trails and routes, though local populations may be replenished with moose from other places that would move into this available habitat.

Access

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). The Bull River and Upper Cantwell Creek Floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

NPS qualified subsistence users would drive ORVs in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 3 would provide access to all of the important lower drainages. The number of moose harvested would continue to depend on where the moose were in any given year.

Construction of the Bull River Access Trail would open more territory (the Bull River Floodplain) to subsistence hunters and the NPS-managed trails would attract more subsistence hunters because they would be in better condition and easier to drive on. While greater use would be expected on NPS-managed trails and routes, off-trail areas would be difficult to access during the fall hunting season due to the restrictions proposed in this alternative (no off-trail use of ORVs for any purpose).

An expanded winter subsistence moose hunt would provide additional opportunities to hunt moose. Snowmachine travel during winter would provide much broader access in less time throughout the TUA than is possible during late summer and fall either by ORV or on foot. In addition, cold weather would make it easier to prevent meat spoilage, snow cover would provide an ideal substrate for clean handling of meat, and snowmobiles and sleds would provide an easier way to transport meat. A winter hunt is an important component of the overall long-term beneficial impacts resulting from the management actions in Alternative 3.

The overall effect would be that under this alternative a hunter would realize some limiting factors (no off-trail use allowed) on access to subsistence hunting while benefiting from improved trails (especially being able to count on NPS-managed trails and routes from one season to the next), a new Bull River Access Trail, improved access to the Bull River and Upper Cantwell Creek Floodplains, and additional access to hunting opportunities in winter.

Competition among NPS qualified subsistence users

Alternative 3 would result in increased competition among NPS qualified subsistence users because more subsistence hunters would be expected to use the TUA than in the past, and because use would tend to be concentrated along the NPS-managed trails and routes. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. Construction of the Bull River Access Trail would open more territory to subsistence hunters and the maintained identified trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

There would be an immediate increase in competition along NPS-managed trails and routes. This increased competition would likely continue over the long term because NPS-managed trails and routes are in important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits).

The advantages of hunting by snowmobile (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) would likely result in greater hunter participation, especially over the long term.

These factors could result in a return to state lands by a small minority of the hunters. However, those hunters who harvest game farther from identified trails and routes and who are willing to use non-motorized means of retrieval would benefit from less competition. Over the long term, there would likely be an increase in subsistence activity off trail as more hunters became willing to use alternative methods of game retrieval, including horsepacking.

Way of Life

Subsistence use would continue to provide a considerable proportion of the rural diet during the life of this plan because subsistence use would be managed in order to protect natural and healthy wildlife populations. The opportunity for children to learn from elders to identify resources, methods of harvest, and efficient and non-wasteful processing and preparation of moose would continue as it has in the past. However, some subsistence values may be slightly affected due to restrictions on off-trail ORV use since this would require a slight change in tradition. While management for sustainable use would protect these subsistence values, successful moose hunts would require more time and effort during the fall hunting season because of the restrictions on off-trail use of ORVs. Hunts may require less time and effort during the winter hunt. Since ORVs would not be allowed off-trail, less-mobile users would have to shoot an animal very close to the NPS-managed trails since they would not be allowed to use an ORV for retrieval. This could take more time and effort and possibly displace some users to other areas. The winter hunt would provide an additional opportunity for mobile and less-mobile users; however, a winter hunt would require a change in traditions.

Economic Analysis

The economic analysis can be determined based on the effect of each alternative on the total annual number of moose harvested by Cantwell subsistence hunters both inside and outside the TUA. Competition for subsistence moose hunting opportunities on general State lands within GMU 13E is increasing, and Cantwell residents have started shifting their hunting effort towards park lands (park lands in Unit 13E Cantwell area and in Unit 20C Kantishna Hills). This trend would continue and subsistence hunters could depend on hunting on park lands for more than half of the moose the Cantwell community needs in the future (Callaway 2006). In 1999, 27 moose were harvested by the Cantwell community from State and park lands (ADFG 2002). Using this number as a baseline for how many moose harvests would continue to be needed by the community, then 13-14 of those moose would have to come from park lands in the future.

We assume the TUA can't support a harvest of 13-14 moose/year (see Alternative 1 assumptions), but it can support an average of 5 moose harvested from the TUA (or slightly more up to some harvest limit). For this exercise we assume the limit would be 5 moose. Therefore, subsistence hunters could have to turn to *other* park lands in 13E and 20C to find the remaining 8-9 moose they need. At most, if those 8-9 moose couldn't be harvested, it would be a loss of 8-9 moose for the community per year. If a dressed moose weighs 1,000 pounds, this is a loss of 8,000-9,000 pounds of moose meat to the community per year. At a market basket estimate of $8/lb, this would be a shortfall in dollars of nearly $64,000 to $72,000 – or a loss of $640 to $720 per household (assuming 100 subsistence households in Cantwell residence zone).

Though income levels in Cantwell may fluctuate from year to year, the median family income for Cantwell for 2000 was $39,792 (U.S. Census 2000). An economic loss of $640 to $720 for a family would be a loss of 1.6% – 1.8% of their annual income.

Cumulative Impacts

In addition to the cumulative impacts on subsistence use resulting from past, present, and reasonably foreseeable future actions, the following applies under this alternative:

- ANILCA allows snowmachines for subsistence, for traditional activities, and for travel to and from villages and homesites (ANILCA 811 and 1110). During the 1990s, technological improvements in snowmachines enabled a large but unquantified expansion of snowmachine use in Denali. Accurate estimates of snowmachine users are difficult to make, but during March and April of 1999, the NPS estimated that there were between 1,500 and 2,000 snowmobile users along the Parks Highway, primarily in the region from Cantwell to the West Fork of the Chulitna River and the Tokositna River area (NPS 2000a).

Non-subsistence snowmachine use in the TUA could scare wildlife, creating more of a challenge for NPS qualified subsistence users. Increases in the Cantwell population and increases in the overall number of hunters would continue to increase competition in the TUA. Because of the impacts to subsistence resources and due to the increased competition for hunting in general, these past, present, and future actions would have a moderate adverse impact on subsistence use in the TUA. The actions in Alternative 3 would counteract these effects to some extent because of additional ORV access and proactive wildlife management. The cumulative adverse impact of this alternative plus these past, present, and future actions would therefore be minor.

Conclusion

Alternative 3 would result in minor beneficial impacts to subsistence resources and opportunities because of improved access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Greater access to subsistence resources and opportunities would result from improvements to NPS-managed trails and routes, a new Bull River Access Trail, and improved access to the Bull River and Upper Cantwell Creek Floodplains. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term and remove uncertainty for NPS qualified subsistence users. The identified ORV trails and routes would be in good moose habitat, so harvests would be expected to increase. There would also be a winter hunt extending as long as possible, which if established would provide additional subsistence opportunities. Counteracting these benefits, however, would be restrictions on ORV use and increased competition among hunters in the

TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term.

The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.

4.9.6 Impacts to Subsistence Opportunities Under Alternative 4

Alternative 4 would result in minor adverse impacts to subsistence resources and opportunities. Access would be more difficult since ORV use would be allowed only on NPS-managed trails, and only beginning one week before the opening of hunting season. Competition among hunters in the TUA would increase, especially in and near the access corridors. However, a winter hunt would provide additional subsistence opportunities, and NPS qualified subsistence users would have the option of using other hunting and retrieval methods such as travel by horseback or on foot. Monitoring and proactive management, including subsistence harvest limits for moose and caribou, would provide for sustainable harvest over the next 10-15 years.

Subsistence resources

Moose harvests in the TUA would remain close to the current average of 5 moose harvested/year (based on past 15-year average). Wolves would be negatively impacted with the addition of a winter hunt. Noise from administrative use of helicopters, airplanes, ORVs, and snowmachines would disturb wildlife. These factors would result in some adverse impacts to the availability of subsistence resources (particularly moose and wolves). However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. This alternative also proposes that the NPS monitor the number of wolf harvests and, if necessary, a limit would be proposed to maintain natural and healthy wolf populations.

Since ORVs would be restricted to NPS-managed trails for scouting game, it is likely that more moose would be harvested closer to trails, assuming moose have come down from the headwaters. Greater numbers of moose harvested near trails could affect local moose populations along the Cantwell Creek and Windy Creek, though local populations may be replenished with moose from other places that would move into this available habitat.

Access

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail. NPS-managed trails would be maintained and would attract more subsistence hunters because they would be in better condition and easier to drive on. However, it would be difficult for NPS qualified subsistence users to access the Bull River and Upper Cantwell Creek Floodplains during fall hunting season. Alternative 4 would provide access to some, but not all, of the important lower drainages.

The NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt,

primarily in the area southwest of Cantwell Creek and into the Bull River area. An expanded winter subsistence moose hunt would provide additional opportunities to hunt moose. Snowmachine travel during winter would provide much broader access in less time throughout the TUA than is possible during late summer and fall either by ORV or on foot. In addition, cold weather would make it easier to prevent meat spoilage, snow cover would provide an ideal substrate for clean handling of meat, and snowmobiles and sleds would provide an easier way to transport meat.

The overall effect would be that under this alternative a hunter would realize a number of limiting factors on access to subsistence hunting while benefiting from improved trails (especially being able to count on NPS-managed trails and routes from one season to the next), and additional access to hunting opportunities in winter.

Competition among NPS qualified subsistence users

Alternative 4 would result in increased competition among NPS qualified subsistence users along NPS-managed trails and routes because use would increase and tend to be concentrated in these locations. This increased competition would likely continue over the long term because NPS-managed trails and routes are in important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits).

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

The advantages of hunting by snowmobile (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) would likely result in greater hunter participation, especially over the long term.

These factors could result in a return to state lands by a small minority of the hunters. However, those hunters who harvest game farther from identified trails and routes and who are willing to use non-motorized means of retrieval would benefit from less competition. Over the long term, there would likely be an increase in subsistence activity off trail as more hunters became willing to use alternative methods of game retrieval, including horsepacking.

Way of Life

Subsistence use would continue to provide a considerable proportion of the rural diet during the life of this plan because subsistence use would be managed in order to protect natural and healthy wildlife populations. The opportunity for children to learn from elders to identify resources, methods of harvest, and efficient and non-wasteful processing and preparation of moose would be somewhat threatened because subsistence users' traditions would have to change. For example, more people may have to rely on a winter hunt, which while it could be a good opportunity to hunt, share, and learn new skills, it breaks away from the traditional fall hunt. Another break in tradition would be that ORVs would be restricted to NPS-managed trails and ORVs would be allowed only one week prior to hunting season. This would be a change for many hunters.

While management for sustainable use would protect subsistence resources, successful moose hunts would require more time and effort during the fall hunting season because of the restrictions on use of ORVs. Hunts may require less time and effort during the winter hunt. Since

ORVs would not be allowed off-trail, less-mobile users would have to shoot an animal very close to the NPS-managed trails since they would not be allowed to use an ORV for retrieval. This could take more time and effort and possibly displace some users to other areas. The winter hunt would provide an additional opportunity for mobile and less-mobile users; however, a winter hunt would require a change in traditions.

Economic Analysis

The economic analysis can be determined based on the effect of each alternative on the total annual number of moose harvested by Cantwell subsistence hunters both inside and outside the TUA. Competition for subsistence moose hunting opportunities on general State lands within GMU 13E is increasing, and Cantwell residents have started shifting their hunting effort towards park lands (park lands in Unit 13E Cantwell area and in Unit 20C Kantishna Hills). This trend would continue and subsistence hunters could depend on hunting on park lands for more than half of the moose the Cantwell community needs in the future (Callaway 2006). In 1999, 27 moose were harvested by the Cantwell community from State and park lands (ADFG 2002). Using this number as a baseline for how many moose harvests would continue to be needed by the community, then 13-14 of those moose would have to come from park lands in the future.

We assume the TUA can't support a harvest of 13-14 moose/year (see Alternative 1 assumptions), but it can support an average of 5 moose harvested from the TUA (or slightly more up to some harvest limit). For this exercise we assume the the limit would be 5 moose. Therefore, subsistence hunters could have to turn to *other* park lands in 13E and 20C to find the remaining 8-9 moose they need. At most, if those 8-9 moose couldn't be harvested, it would be a loss of 8-9 moose for the community per year. If a dressed moose weighs 1,000 pounds, this is a loss of 8,000-9,000 pounds of moose meat to the community per year. At a market basket estimate of $8/lb, this would be a shortfall in dollars of nearly $64,000 to $72,000 – or a loss of $640 to $720 per household (assuming 100 subsistence households in Cantwell residence zone).

Though income levels in Cantwell may fluctuate from year to year, the median family income for Cantwell for 2000 was $39,792 (U.S. Census 2000). An economic loss of $640 to $720 for a family would be a loss of 1.6% – 1.8% of their annual income.

Cumulative Impacts

The cumulative impacts on subsistence use resulting from past, present, and reasonably foreseeable future actions would be the same as for alternative 3. Non-subsistence snowmachine use in the TUA could scare wildlife, creating more of a challenge for NPS qualified subsistence users. Increases in the Cantwell population and increases in the overall number of hunters would continue to increase competition in the TUA. Because of the impacts to subsistence resources and due to the increased competition for hunting in general, these past, present, and future actions would have a moderate adverse impact on subsistence use in the TUA. The actions in Alternative 4 would contribute minor adverse impacts. The cumulative adverse impact of this alternative plus these past, present, and future actions would therefore be moderate.

Conclusion

Alternative 4 would result in minor adverse impacts to subsistence resources and opportunities. Access would be more difficult since ORV use would be allowed only on NPS-managed trails, and only beginning one week before the opening of hunting season. Competition among hunters in the TUA would increase, especially in and near the access corridors. However, a winter hunt

would provide additional subsistence opportunities, and NPS qualified subsistence users would have the option of using other hunting and retrieval methods such as travel by horseback or on foot. Monitoring and proactive management, including subsistence harvest limits for moose and caribou, would provide for sustainable harvest over the next 10-15 years.

The level of impacts to subsistence anticipated from this alternative would not result in a significant restriction to subsistence resources or opportunities.

5.0 CONSULTATION AND COORDINATION

To initiate this EA process, notice of the project was published on the Denali National Park and Preserve webpage and on the NPS Planning, Environment and Public Comment (PEPC) website. Scoping letters were distributed to about 60 agencies, organizations, and individuals. Three public scoping meetings also were held:

November 28, 2005	Cantwell, Alaska	5 members of the public attending
December 15, 2005	Cantwell, Alaska	8 members of the public attending
January 17, 2006	Anchorage, Alaska	2 members of the public attending

In addition to these public scoping meetings, a scoping meeting was held in Anchorage, Alaska, with members of three environmental organizations at their request. In the scoping letters and at the meetings, the NPS discussed the project purpose and need, presented an initial list of management options for comment, solicited the ideas and opinions of the public, and discussed the project EA schedule.

Subsequent to public scoping, the NPS developed a range of preliminary management alternatives. These alternatives were presented to the Denali Subsistence Resource Commission for discussion during their bi-annual meeting on February 10, 2006. The SRC approved Alternative 2 in concept and with modifications. The Alternative 2 that is analyzed in this EA reflects the SRC's modifications.

The preliminary alternatives were presented to the public in a newsletter that was distributed to about 75 agencies, organizations, and individuals for a 30-day public comment period. The newsletter also was posted on the Denali National Park and Preserve webpage and on the NPS Planning, Environment and Public Comment (PEPC) website. Two public meetings were held to discuss the newsletter and solicit public comment:

April 4, 2006	Cantwell, Alaska	6 members of the public attending
April 5, 2006	Anchorage, Alaska	2 members of the public attending

In addition, the NPS met with three representatives of the State of Alaska on April 13, 2006. Discussion during this meeting revolved around specifics of the alternatives and suggestions for modifications.

During the scoping process and in response to the preliminary alternatives newsletter, multiple issues and ideas were brought up by the public. Comments on possible management strategies ranged from suggestions that subsistence ORV use be unlimited to recommendations that various restrictions be imposed to better protect sensitive resources. Several issues were highlighted as needing attention in the EA, including comprehensive descriptions of the existing conditions along the proposed routes and trails; what kind of monitoring strategies would be implemented to track potential resource impacts; how the plan would coordinate with the Backcountry Management Plan standards established for the area; enforcement provisions needed to implement the plan; and the need for the NPS to stipulate how it would deal with funding shortfalls when monitoring and implementing this plan.

An internal draft of the EA was distributed for review to the NPS Alaska Leadership Council, as well as to the State of Alaska. Review comments were collected and the EA was revised for public review.

5.1 LIST OF EA PREPARERS

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APPENDIX 1

ANILCA SECTION 810(A)

SUMMARY OF EVALUATIONS AND FINDINGS

I. Introduction

This evaluation and finding was prepared to comply with Title VIII, Section 810 of the Alaska National Interest Lands Conservation Act (ANILCA). It evaluates the potential restrictions to subsistence uses and needs that could result from proposed actions within the Cantwell Subsistence Off-Road Vehicle Management Environmental Assessment.

II. The Evaluation Process

Section 810(a) of ANILCA states:
"In determining whether to withdraw, reserve, lease, or otherwise permit the use, occupancy, or disposition of public lands . . . the head of the Federal agency . . . over such lands . . . shall evaluate the effect of such use, occupancy, or disposition on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes. No such withdrawal, reservation, lease, permit, or other use, occupancy or disposition of such lands which would significantly restrict subsistence uses shall be affected until the head of such Federal agency:

1. gives notice to the appropriate State agency and the appropriate local committees and regional councils established pursuant to Section 805;

2. gives notice of, and holds, a hearing in the vicinity of the area involved; and

3. determines that (A) such a significant restriction of subsistence uses is necessary, consistent with sound management principles for the utilization of the public lands, (B) the proposed activity would involve the minimal amount of public lands necessary to accomplish the purposes of such use, occupancy, or other disposition, and (C) reasonable steps would be taken to minimize adverse impacts upon subsistence uses and resources resulting from such actions."

ANILCA created new units and additions to existing units of the national park system in Alaska. In reference to the Denali National Park and Preserve additions, ANILCA Section 202(3)(a) states:

"The park additions and preserve shall be managed for the following purposes, among others: To protect and interpret the entire mountain massif, and additional scenic mountain peaks and formations; and to protect habitat for, and populations of fish and wildlife, including but not limited to, brown/grizzly bears, moose, caribou, Dall sheep, wolves, swans and other waterfowl; and to provide continued opportunities including reasonable access, for mountain climbing, mountaineering, and other wilderness recreational activities."

Subsistence is an allowed use in the ANILCA additions to Denali National Park and Preserve (Sec. 202(3)(a)). The potential for significant restriction must be evaluated for the proposed action's effect upon ". . . subsistence uses and needs, the availability of other lands for the purposes sought to be achieved and other alternatives which would reduce or eliminate the use" (Sec. 810(a)).

III. Proposed Action on Federal Lands

This document evaluates four possible alternatives that address the future management of subsistence off-road vehicle use within the TUA. The “Description of Alternatives” section of the environmental assessment describes in detail the alternatives for consideration. Following is a brief summary of each.

Alternative 1: No Action
The NPS would not undertake any new actions to manage subsistence ORV use (see Figure 2.1). NPS qualified subsistence users would continue to employ ORVs for subsistence purposes throughout the TUA. This alternative provides a baseline for evaluating the changes and impacts of the action alternatives.

Use of ORVs off-trail and on existing trails would be allowed for all subsistence purposes by NPS qualified subsistence users throughout the Cantwell Traditional Use Area (TUA). There would be no limits on the types of ORVs that could be used.

No closures are predicted to occur under this alternative.

The NPS would not seek to establish subsistence harvest limits for moose and caribou.

Alternative 2
The only off-trail ORV use permitted by NPS qualified subsistence users would be to retrieve harvested moose and caribou. In addition, use of ORVs by NPS qualified subsistence users engaged in subsistence activities would continue to be allowed on NPS-managed trails and routes (See Figures 2.2 and 2.3).

Subsistence users would be required to obtain a permit in advance from the NPS to use an ORV for off-trail retrieval of harvested moose or caribou. To aid the NPS in monitoring impacts of this off-trail use, the ORV user would be required to provide the NPS with a detailed map, a GPS-tracking log, or similar record identifying the travel path used for retrieval.

The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes:

- Windy Creek Access Trail;
- Windy Creek Bowl Trail;
- Cantwell Airstrip Trail;
- Pyramid Peak Trail; and
- Bull River Access Trail (new construction).

The NPS would implement management prescriptions to improve the existing Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail (see

Appendix 5 for details about the management prescriptions). Both the Bull River and Upper Cantwell Creek floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

To prevent new adverse impacts from being created, the following areas would be permanently closed to ORVs traveling off NPS-managed existing trails or routes:

1. Open water (i.e., areas with equal to or greater than one inch of permanent standing water).
2. Slopes greater than 20%
3. Areas with saturated soils

The NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to establish subsistence harvest limits for moose and caribou as necessary to maintain natural and healthy moose and caribou populations on park lands. The National Park Service would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit.

Alternative 3

The Cantwell Traditional Use Area (TUA) would remain open to use of ORVs by NPS qualified subsistence users for all subsistence purposes only on NPS-managed existing trails and routes. In addition, the NPS would work with the Federal Subsistence Board and others to implement a winter subsistence moose hunt (See Alternative 3 Map).

The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes:

- Windy Creek Access Trail;
- Windy Creek Bowl Trail;
- Cantwell Airstrip Trail;
- Pyramid Peak Trail; and
- Bull River Access Trail (new construction).

Both the Bull River and Upper Cantwell Creek floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

Areas off of NPS-managed existing trails and routes would be closed by regulation to ORV use, including the “recovery closures” as described under Alternative 2.

The NPS would work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Councils to establish subsistence harvest limits for moose and caribou as necessary to maintain natural and healthy moose and caribou populations on park lands. The National Park Service would monitor wolf harvest records from the TUA. If there were any indication of a substantial increase that would affect segments of the population, the NPS would take appropriate management action, which could include proposing a harvest limit.

Alternative 4
Alternative 4 would be similar to Alternative 3, except for the following differences:

1. The NPS would not construct the new Bull River Access Trail.
2. ORVs would not be authorized on either the Bull River or Upper Cantwell Creek Floodplains.
3. The NPS would authorize ORV use for subsistence purposes only on the
    a. Windy Creek Access Trail,
    b. Windy Creek Bowl Trail,
    c. Cantwell Airstrip Trail, and the
    d. Pyramid Peak Trail.
4. ORV use for subsistence purposes would be authorized on these four trails *only* from one week before the beginning of the fall moose and caribou hunting seasons until the end of these hunting seasons.

IV. Affected Environment

Moose
Moose are abundant throughout the year within and near the drainages in the Traditional Use Area (TUA). They inhabit the entire vegetated TUA except tall alder shrubs, forest, and slopes greater than 20%.. Typically, moose occur in the headwaters of the draws in the TUA in August and early part of September and occur closer to the lower corridors later in September and October. Moose concentrations vary seasonally and, during winter, correlate with snow depth and timing (ADFG 1992b). Most calving takes place from late May through June. During calving, cows tend to seek areas within their home range that provide low predator densities (islands in rivers) or improved visibility (open muskeg areas) (ADFG 1996a). Post-calving moose generally move to higher elevations. Fall rutting and post-rutting concentrations occur in subalpine habitats, with moose moving down from these areas in winter as snow depths increase (ADFG 1992a). Riparian willow stands provide a large part of winter forage and upland coniferous forests provide thermal cover and shallower snow depths (ADNR 1991).

Concentrations of moose are often seen mid and late winter in the Windy Creek area above Cantwell and where Ohio Creek emerges from the mountains (NPS unpublished data). Mean density of moose during late winter (late March) ranged from 0.7 to 3.2 moose per square mile on the south side of the Alaska Range (ADFG 1990b). In the most recent NPS survey in November 2005, the entire TUA was surveyed, and 102 moose were seen. Moose were seen throughout the TUA with most of the moose seen near Cantwell Creek and 21 near Windy. This represents a mean density of 1.9 moose per square mile in the area surveyed. The bull/cow ratios show signs of stress to the population. In 200S5 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

A large rutting concentration roughly coincides with caribou calving grounds in the higher country north of Broad Pass between Windy Creek and the Bull River (ADNR 1985; ADFG 1985a). The drainages in the area of the old Dunkle Mine – the upper Bull River, Costello and Cantwell creeks, and the West Fork of the Chulitna – are identified as prime early-winter moose range (NPS 1984; ADNR 1985).

Since 1992 the National Park Service conducted four moose surveys that encompassed the TUA. The following table shows estimates of moose per square mile, and calf/cow and bull/cow ratios.

These surveys covered a 215 square mile area from Windy Creek to the West Fork of the Chulitna River.

Year	Calves per 100 Cows	Bulls per 100 Cows	Density per Square Mile
1992	29.5	29.5	1.4
1993	28.1	31.3	0.7
1995	23.6	27.6	0.9
2005	19.5	47.4	1.2

A more comprehensive description of existing conditions can be found in the affected environment section of the environmental analysis.

V. Subsistence Uses and Needs Evaluation

One of the purposes of ANILCA is to provide the opportunity for local, rural residents engaged in a subsistence way of life to continue to do so. Accordingly, Congress provided for traditional subsistence uses by qualified local rural residents within the ANILCA additions to Denali National Park and Preserve, including the TUA. Local rural residents engage in, and depend upon, resources from the park and preserve for personal consumption, cultural identity, and to maintain a subsistence way of life.

In addition to describing the specific purposes for which Denali National Park and Preserve is to be managed, Section 202(3)(a) of ANILCA provided that "subsistence uses by local residents shall be permitted in the additions to the park where such uses are traditional in accordance with the provisions in title VIII." Under Title VIII of ANILCA, Section 811(a) states that "rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on public lands." Subsistence access is further addressed in section 811(b) where it states that "the Secretary [of the Interior] shall permit on the public lands appropriate use for subsistence purposes of snowmobiles, motorboats and other means of surface transportation traditionally employed for such purposes by local residents, subject to reasonable regulation."

In authorizing subsistence uses within Denali National Park and Preserve additions, Congress intended that traditional National Park Service management policies be maintained which strive to maintain the natural abundance, behavior, diversity, and ecological integrity of native animals as part of their ecosystem, while recognizing that subsistence use by local rural residents have been, and are now, a natural part of the ecosystem serving as a primary consumer in the food chain. In addition to providing for traditional subsistence opportunities, Congress directed the NPS to take appropriate steps when necessary to insure that consumptive uses of resources within the park and preserve not be allowed to adversely disrupt the natural balance which has been maintained for thousands of years (Senate Report p. 171, top para.).

The continuation of traditional subsistence activities depends directly on the availability of healthy and diverse wildlife, plant and fish populations. The natural diversity and abundance of resources important to subsistence activities is, in turn, directly dependent upon intact and healthy ecosystems.

On July 1, 1990 the Federal Government assumed responsibility for the management of subsistence taking of fish and wildlife on Federal public lands in Alaska. The Federal Subsistence

Board (FSB) was established to oversee the Federal Subsistence Program and is the decision making body that makes rural/non-rural determinations, customary and traditional use determinations which define what communities and areas have subsistence use of wildlife populations, which species and populations are subject to harvest, when seasons open and close, how many animals may be harvested, and the method and means by which an animal may be taken. The subsistence harvest of wildlife in Denali National Park and Preserve by NPS qualified subsistence users is subject to Federal subsistence management regulations. Annually any person, agency or group may submit proposals to change Federal subsistence regulations. The Federal Subsistence Board uses the Emergency Action process if immediate action is needed to resolve fish and wildlife issues. Emergency Actions are authorized and in accordance with 50 CFR 100.19(d) and 36 CFR 242.19(d).

The purpose of the Denali Subsistence Resource Commission (SRC) is to devise and recommend to the Secretary of the Interior and the Governor of Alaska a program for subsistence hunting within Denali National Park, and to annually recommend changes to the program. The Regional Advisory Councils review and make recommendations to the Federal Subsistence Board on proposals for regulations, policies, management plans, and other subsistence related issues on Federal public lands within the region; develop proposals pertaining to the subsistence harvest of fish and wildlife; review proposals others submit; encourage and promote local participation in the decision making process affecting subsistence harvests on Federal public lands; make recommendations on customary and traditional use determinations of subsistence resources; and appoint members to national park subsistence resource commissions.

The NPS determines eligible local rural subsistence users through the use of resident zone communities and issuance of subsistence use permits. The community of Cantwell is identified as a subsistence resident zone community containing a significant concentration of residents who have customarily and traditionally used Denali National Park lands for subsistence purposes. In 1981 after consultation with Denali's Subsistence Resource Commission (SRC), boundaries for this resident zone community were established. Resident zones authorize all permanent residents within these zones to participate in subsistence activities on NPS lands without a subsistence use permit. Individuals who reside outside of the resident zone communities, who have customarily and traditionally used park subsistence resources, may apply to the Superintendent for a subsistence use permit. Approximately 100 households qualify for subsistence use activities within the Cantwell TUA.

The number of federal registration permits issued in Cantwell in recent years (NPS 2005c):

Year	**2003**	**2004**	**2005**	**2006**
Caribou (two per applicant)	47x2	77x2	68x2	38x2
Moose (one per household)	78	88	82	36

In 1991, a decision was made that Native select lands were not federal public lands and were, therefore, closed to federal subsistence use. This closed significant portions of Cantwell Creek and Windy Creek. In 1999, fisheries regulations passed and these lands again were open to federal subsistence use. ANILCA Section 811(b) states that "...the Secretary shall permit on the public lands..." Section 102(3) defines "public lands" as Federal Lands in Alaska, to exclude validly selected State and Native Corporation lands. Thus, Section 811 did not authorize the use of ORVs on selected lands, even where found to be "traditionally employed," for subsistence

purposes. It also appears that 811(a) did not authorize subsistence uses at all on those selected lands (Title II authorizations always refer to the "provisions of Title VIII"). The 1991 changeover from State to Federal management of subsistence hunting on Conservation System Units should not have changed anything. When subsistence fishing was added to federal management in 1999, the new regulations setting up the Federal Subsistence Board amended the ANILCA definition of "Public Lands" under the authority of ANILCA Section 906(o)(2), and made the change in 50 CFR 100.4 Definition of Public Lands (2).

The State and AHTNA selected lands comprise about 70% of the TUA between Cantwell Creek and the northeast border of the TUA and less than 3% of the TUA between Cantwell Creek and the Bull River. State and Native Corporation selected lands have not been surveyed, patented or interim conveyed, and because of over-selections, they may never get transferred out of federal ownership.

The NPS determined in the 1986 Denali General Management Plan (GMP) that ORVs had not been regularly used for subsistence purposes and were not considered a traditional means of subsistence access. However, in the 1990's, eight Cantwell subsistence users and the Denali Subsistence Resource Commission (SRC) requested that the Superintendent review and reconsider the 1986 GMP determination in light of new information provided by Cantwell residents regarding their traditional use of ORVs for access to subsistence resources. In response to these requests, and in compliance with ANILCA and NPS regulations and policies, the NPS undertook a project to compile and review traditional access information for the Cantwell area. The scope of this review and report was limited to the Cantwell area because the request was specific to that community and adjacent Denali National Park lands regarding traditional subsistence ORV access for the Cantwell area.

Based on the information in the review, the National Park Service made its final Cantwell Subsistence Traditionally Employed ORV Determination (hereby incorporated by reference), in July 2005, which opened the entire Cantwell traditional ORV use area to the use of ORVs for subsistence purposes. On August 1, 2005 the National Park Service implemented a temporary 120-day closure to protect park resources in the area where Cantwell residents traditionally employed ORVs for subsistence purposes that was identified in the Determination. Three existing trails (Windy Creek Access Trail, Cantwell Airstrip Trail, Upper Cantwell Creek Floodplain Route) were exempted from this closure. The closure allowed reasonable access to subsistence resources for residents of Cantwell while protecting park resources and providing time for the National Park Service to complete the necessary field work and environmental documentation evaluating ORV effects on park resources and values. In 2006, the National Park Service implemented an identical closure.

Subsistence activities are dynamic and diverse with moose and caribou hunting usually occurring in August and September. Cantwell subsistence hunters typically look closest to home first, using Windy Creek, Cantwell Creek, then farther south in the TUA. If unsuccessful, they hunt along the Denali Highway and then Kantishna (NPS 2006c). Stricter state regulations for moose hunts on state lands, decreased moose populations on state lands, and increased competition with other hunters encourage subsistence hunters to use park lands.

Federal subsistence moose season is open August 1 – September 20, and caribou season is open August 10- September 30 and October 21 – March 31. Both hunts require a Federal registration permit. One moose permit will be issued per household. The harvest limit for moose is one antlered bull moose, and the harvest limit for caribou is two bulls. There are currently no quotas for annual unit-wide harvests of moose or caribou.

Retrieval of game occurs on foot or by ORVs used on trails that are open for such use. Most harvests are likely supported by ORV use (NPS 2005). The 2005 Cantwell Subsistence Traditionally Employed ORV Determination indicates there were a variety of corridors and routes available for mechanized access by businesses as well as local residents for subsistence into areas that are now included within the ANILCA park additions. Information contained in the 1992 affidavits, 1993 ATV interviews and mapping, and the 2005 oral history project demonstrates there has been evolution of mechanized equipment used over time by Cantwell NPS qualified subsistence users along the primary routes along Windy and Cantwell Creek corridors, and into adjacent areas for subsistence harvests. Sections of intermittent ORV trails leading from the southwest side of Cantwell Creek into the Bull River drainage were also observed on park additions during the 1981 aerial survey.

In 2000, about 50% of the nearly 100 subsistence-eligible households in Cantwell attempted to harvest moose, with about 25% successful. Because there are so many factors involved with a successful hunt, it would be difficult to correlate ORV use with harvest levels. There is little evidence that horses have been used to retrieve game from the TUA.

Winter hunting opportunities exist for caribou and many other furbearers and small game species. However, in recent formal and informal public meetings, eligible Cantwell residents have generally not talked about winter hunting, particularly for moose and caribou, as an important part of traditional ways.

There are traditions, among Natives and other hunters, that meat is not good in some seasons, e.g. caribou during the rut. Caribou and moose on poorer range lose fat and meat quality in late winter. But based on the widespread acceptance of the state's winter hunts for both species, and personal experience, McNay (ADFG 2006d) believes that winter meat quality is not a problem. The customary hunting practices of the late 20th century were based in part on the state's fall hunting seasons, which were in turn based on the ease of water access, ease of hunting animals during the rut, and general hunting traditions. Prehistorically, McNay (ADFG 2006d) suspects that there was a pulse of hunting activity in the fall based on water access and another in the winter based on snow travel. The state's December-January moose and caribou hunts, which are scattered around the state, are widely popular, including a winter subsistence hunt within the north side of Denali National Park in Unit 20C. In remote areas without electricity, people have often asked for hunting seasons to be moved later in the year to solve the problem of keeping meat cold (ADFG 2006d).

Figure 3.8 shows moose harvests in the Cantwell TUA from 1991 – 2006 (NPS 2006c, USFW 2007b, ADFG 2007). This information comes from NPS records maintained by the Subsistence Program Manager for Denali National Park and Preserve as well as Federal Subsistence Registration data provided by the Office of Subsistence Management at the U.S. Fish and Wildlife Service. Although Cantwell residents generally comply with reporting requirements, harvest counts could be off by as much as 15% due to underreporting or other sources of error (NPS 2006c).

Figure 3.8. Subsistence Moose Harvests in Denali National Park: 1991 – 2006.

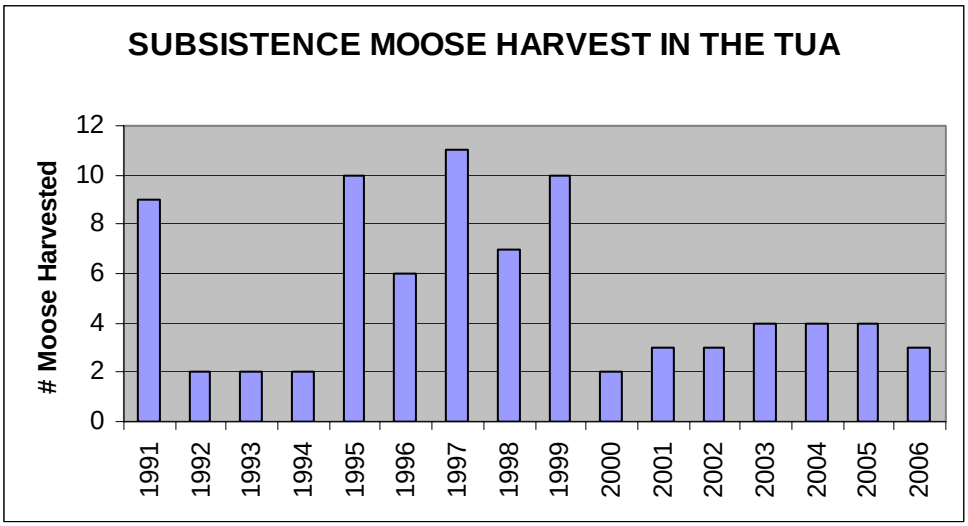

Figure 3.8 shows that there has been an average of 5.1 moose harvested per year in the TUA. Harvest levels in current years have been near, or slightly above or below, sustainable levels. This can be seen by looking at total moose population in the area and bull/cow ratios. The bull/cow ratios show signs of stress to the population. In 2005 there were 65 cows and 29 bulls, a 45:100 ratio, with 8 calves (NPS 2005b). NPS wildlife biologists have concluded that these numbers generally do not show an excess population that can be harvested.

The ADF&G does not provide a caribou hunting season in GMU 20C, which includes most of the range of the Denali herd. However, a variable percentage of the Denali herd crosses back and forth over the Alaska Range. This means some of the Denali herd winters in GMU 13E, where they can be legally harvested on state and private lands by all hunters, and on ANILCA park lands -- including the TUA -- by qualified subsistence hunters.

Another subsistence activity is trapping, but this is conducted during winter by snowmachine and therefore would not be affected by the different ORV management provisions being proposed.

Potential Impacts to Subsistence Users

Impacts to subsistence include restricting access to subsistence resources, limiting the availability of subsistence resources, and increasing competition for subsistence resources. Availability of resources can vary under different management options. Different types of access options can affect the level of effort required, time involved, and the effectiveness of the hunt. Competition will increase or decrease depending on the management action. These items can negatively affect the subsistence user by making subsistence activities more difficult and time-consuming, limiting the amount of food or supplies the subsistence user can obtain, and altering the subsistence user's traditional way of life and quality of life.

Evaluation Criteria

To determine the potential impacts of the alternatives on existing subsistence activities, three evaluation criteria were analyzed relative to existing subsistence resources:

1. The potential to reduce important subsistence fish and wildlife populations by (a) reductions in number, (b) redistribution of subsistence resources, or (c) habitat losses;
2. What effect the action might have on subsistence fisher or hunter access;
3. The potential for the action to increase fisher or hunter competition for subsistence resources.

1. The potential to reduce populations

(a) Reduction in Numbers:

Alternative 1
Levels of moose harvest would increase dramatically over the current average of 5 moose per year. Moose harvests would initially increase; then the population may become depleted as there is not a large enough bull moose population to sustain an annual taking of 10 moose. While the initial increased moose harvest would benefit subsistence hunters, within a few years the hunting pressure would likely remove or displace moose in important hunting areas, reducing the number of moose that could be harvested from the TUA in general. This lower harvest level would mean that NPS qualified subsistence users would have to expend more time and effort hunting outside the TUA. Because of increased pressure on resources and increased competition outside the TUA, hunting outside the TUA would not guarantee success for subsistence hunters.

Alternative 2
The number of moose harvested each year could increase above the current average of 5 moose/year. However, this alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. The harvest limit would counteract the potential threat of over-harvest and decreased resource availability, thus providing a benefit to subsistence hunters.

Alternative 3
Moose harvests in the TUA would at least continue to average 5 moose harvested/year (based on past 15-year average) or could increase up to set harvest limit levels. This alternative proposes that the NPS work with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. This alternative also proposes that the NPS monitor the number of wolf harvests and, if necessary, a limit would be proposed to maintain natural and healthy wolf populations.

Since ORVs would be restricted to NPS-managed trails for scouting game, it is likely that more moose would be harvested closer to trails, assuming moose have come down from the headwaters. Greater numbers of moose harvested near trails could affect local moose populations along the Cantwell Creek, Windy Creek, and Bull River Access Trails and routes, though local populations may be replenished with moose from other places that would move into this available habitat.

Alternative 4
Moose harvests in the TUA would remain close to the current average of 5 moose harvested/year (based on past 15-year average). Wolves would be negatively impacted with the addition of a winter hunt. These factors would result in some adverse impacts to the availability of subsistence resources (particularly moose and wolves). However, this alternative proposes that the NPS work

with the Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to establish subsistence harvest limits for moose to maintain natural and healthy populations on park land within the TUA. This alternative also proposes that the NPS monitor the number of wolf harvests and, if necessary, a limit would be proposed to maintain natural and healthy wolf populations.

Since ORVs would be restricted to NPS-managed trails for scouting game, it is likely that more moose would be harvested closer to trails, assuming moose have come down from the headwaters. Greater numbers of moose harvested near trails could affect local moose populations along the Cantwell Creek and Windy Creek, though local populations may be replenished with moose from other places that would move into this available habitat.

(b) Redistribution of Resources:

Alternative 1
This alternative assumes administrative helicopter, airplane, and ORV use for monitoring purposes, and a high level of ORV use for subsistence purposes during hunting season and prior to hunting season. It is assumed that this alternative would have the highest amount of administrative helicopter and ORV use. The amount of aircraft use for monitoring for any given place would usually be minimal, in that this would mostly be reconnaissance-level work over the area for periodic mapping, and then point-to-point shuttles to get crews out to do monitoring measurements, where needed. Generally, helicopters and airplanes would cross back and forth over the TUA several times a day for several days a week during this time period. Administrative helicopter use generally won't occur in the fall to avoid impacting hunters. Law enforcement use of airplanes would occur throughout the summer and fall seasons. For the monitoring effort, the park would try to avoid using ORVs. However, when ORVs were necessary, they would not be used off of NPS-managed ORV trails and routes. Wildlife would be expected to return to areas of disturbance once the disturbance is removed. Some individuals would be temporarily displaced but the duration and frequency of noise events is not expected to cause any population-level impacts.

Alternative 2
The effect of this alternative on the redistribution of resources would be the same as for alternative 1.

Alternative 3
In addition to the impacts on the redistribution of resources described under alternative 1, under this alternative a winter hunt would introduce additional snowmachine use in the area. Noise from snowmachines would disturb wildlife throughout the winter, though it is not likely that the duration and frequency of snowmachine use that would occur for subsistence purposes would have any lasting impact on any wildlife population in the TUA because of the dispersed and temporary nature of the disturbance and the amount of snowmachine use that the hunt would produce, in comparison to existing levels of snowmachine use that occurs in the area for non-subsistence purposes.

Alternative 4
Impacts from this alternative would be the same as for alternative 3 except that ORV use for subsistence purposes would not be allowed until one week before hunting season opens, so noise impacts and associated disturbance to wildlife, would be less during most of the summer.

(c) Habitat Loss:

None of the alternatives would result in significant habitat loss.

2. Restriction of Access:

Access for subsistence uses on the ANILCA park and preserve additions is granted pursuant to Sections 811(a)(b) and 1110(a). Section 811(b) of ANILCA states that "rural residents engaged in subsistence uses shall have reasonable access to subsistence resources on the public lands." Section 1110(a) of ANILCA authorizes the use of snowmachines for traditional activities during periods of adequate snow cover.

Alternative 1
Both on-trail and off-trail ORV use would be allowed for all subsistence purposes by NPS qualified subsistence users throughout the TUA. People would use ORVs primarily in August and September, anywhere in the TUA, with any type of machine. NPS qualified subsistence users would continue to drive ORVs throughout the TUA in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 1 would provide complete access to both the lower drainages and the head waters because of the lack of restrictions on ORVs. The effect is that under this alternative a subsistence hunter could travel throughout the TUA by ORV for scouting, hunting, and game retrieval, improving their chances of a successful hunt. However, the number of moose harvested would continue to depend on where the moose were in any given year.

Improvements to existing ORV trails would not be made, so while access would be very open, the condition of the ORV trails would continue to deteriorate.

Alternative 2
Off-trail ORV use would be permitted by NPS qualified subsistence users only for retrieval of harvested moose and caribou. In addition, use of ORVs for all subsistence purposes would continue to be allowed on NPS-managed trails and routes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). Both the Bull River and Upper Cantwell Creek floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

Construction of the Bull River Access Trail would open more territory (the Bull River floodplain) to subsistence hunters and the NPS-managed trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

Access patterns under Alternative 2 would include use of ORVs primarily in August and September along the NPS-managed trails and routes. NPS qualified subsistence users would drive ORVs in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 2 would provide access to all of the important lower drainages. The number of moose harvested would continue to depend on where the moose were in any given year.

Alternative 2 would also provide the option of using ORVs for retrieval of harvested moose and caribou, although closures within the TUA may limit any large-scale benefits of this. Management actions would make it more difficult to use an ORV to retrieve a moose far from an

NPS-managed trail or route than is currently the case. As a result, subsistence hunters would likely spend more time looking for moose closer to the trails, and off-trail areas could get very little use. However, some hunters would still harvest these animals off-trail even if they could not use an ORV to retrieve them.

The overall effect would be that under this alternative a hunter would realize some limiting factors on access to subsistence hunting while benefiting from improved trails, a new Bull River Access Trail, and improved access to the Bull River and Upper Cantwell Creek floodplains.

Alternative 3

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. Instead, the NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. The following trails would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, Pyramid Peak Trail, and Bull River Access Trail (new construction). The Bull River and Upper Cantwell Creek floodplains would be managed by the NPS for continued ORV use by NPS qualified subsistence users for all subsistence purposes.

NPS qualified subsistence users would drive ORVs in search of moose and caribou both during the pre-season scoping period and during hunting season. Moose are typically in the headwaters of the draws in August and the early part of September and nearer the lower corridors later in September and October. Alternative 3 would provide access to all of the important lower drainages. The number of moose harvested would continue to depend on where the moose were in any given year.

Construction of the Bull River Access Trail would open more territory (the Bull River floodplain) to subsistence hunters and the NPS-managed trails would attract more subsistence hunters because they would be in better condition and easier to drive on. While greater use would be expected on NPS-managed trails and routes, off-trail areas would be difficult to access during the fall hunting season due to the restrictions proposed in this alternative (no off-trail use of ORVs for any purpose).

An expanded winter subsistence moose hunt would provide additional opportunities to hunt moose. Snowmachine travel during winter would provide much broader access in less time throughout the TUA than is possible during late summer and fall either by ORV or on foot. In addition, cold weather would make it easier to prevent meat spoilage, snow cover would provide an ideal substrate for clean handling of meat, and snowmobiles and sleds would provide an easier way to transport meat. A winter hunt is an important component of the overall long-term beneficial impacts resulting from the management actions in Alternative 3.

The overall effect would be that under this alternative a hunter would realize some limiting factors (no off-trail use allowed) on access to subsistence hunting while benefiting from improved trails (especially being able to count on NPS-managed trails and routes from one season to the next), a new Bull River Access Trail, improved access to the Bull River and Upper Cantwell Creek floodplains, and additional access to hunting opportunities in winter.

Alternative 4

There would be no off-trail use of ORVs for subsistence, or any other, purposes within the TUA. The following trails would be managed by the NPS for continued ORV use by NPS qualified

subsistence users for all subsistence purposes *only* from one week before the beginning of the fall moose and caribou hunting seasons through to the end of these hunting seasons: Windy Creek Access Trail, Windy Creek Bowl Trail, Cantwell Airstrip Trail, and Pyramid Peak Trail. NPS-managed trails would be maintained and would attract more subsistence hunters because they would be in better condition and easier to drive on. However, it would be difficult for NPS qualified subsistence users to access the Bull River and Upper Cantwell Creek floodplains during fall hunting season. Alternative 4 would provide access to some, but not all, of the important lower drainages.

The NPS would work with Federal Subsistence Board, the Denali Subsistence Resource Commission, and the Regional Advisory Council to implement a winter subsistence moose hunt, primarily in the area southwest of Cantwell Creek and into the Bull River area. An expanded winter subsistence moose hunt would provide additional opportunities to hunt moose. Snowmachine travel during winter would provide much broader access in less time throughout the TUA than is possible during late summer and fall either by ORV or on foot. In addition, cold weather would make it easier to prevent meat spoilage, snow cover would provide an ideal substrate for clean handling of meat, and snowmobiles and sleds would provide an easier way to transport meat.

The overall effect would be that under this alternative a hunter would realize a number of limiting factors on access to subsistence hunting while benefiting from improved trails (especially being able to count on NPS-managed trails and routes from one season to the next), and additional access to hunting opportunities in winter.

3. Increase in Competition:

Alternative 1
Alternative 1 would result in increased competition among NPS qualified subsistence users because more subsistence moose hunters would be expected to use the TUA, greater access, and subsequent decrease in availability of moose. In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season. The effect of these factors is that there would be an immediate increase in competition for limited numbers of moose.

Alternative 2
As under Alternative 1, Alternative 2 would result in increased competition among NPS qualified subsistence users because more subsistence hunters would be expected to use the TUA than in the past, and because use would be focused on a finite number of NPS-managed trails and routes.

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

These factors would result in increased competition for subsistence resources. Increased competition is likely to continue over the long term because the NPS-managed trails and routes are in the most important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits). This could result in a return to state

lands by a small minority of the hunters. Those hunters who harvest game farther from identified trails and routes would benefit from less competition.

Alternative 3

Alternative 3 would result in increased competition among NPS qualified subsistence users because more subsistence hunters would be expected to use the TUA than in the past, and because use would tend to be concentrated along the NPS-managed trails and routes. ORV use would also increase because the NPS-managed trails would be maintained/improved in better condition, and the Bull River Access Trail would be constructed, making access of the Bull River Floodplain possible/easier. Construction of the Bull River Access Trail would open more territory to subsistence hunters and the maintained identified trails would attract more subsistence hunters because they would be in better condition and easier to drive on.

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

There would be an immediate increase in competition along NPS-managed trails and routes. This increased competition would likely continue over the long term because NPS-managed trails and routes are in important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits).

The advantages of hunting by snowmobile (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) would likely result in greater hunter participation, especially over the long term.

These factors could result in a return to state lands by a small minority of the hunters. However, those hunters who harvest game farther from identified trails and routes and who are willing to use non-motorized means of retrieval would benefit from less competition. Over the long term, there would likely be an increase in subsistence activity off trail as more hunters became willing to use alternative methods of game retrieval, including horsepacking.

Alternative 4

Alternative 4 would result in increased competition among NPS qualified subsistence users along NPS-managed trails and routes because use would increase and tend to be concentrated in these locations. This increased competition would likely continue over the long term because NPS-managed trails and routes are in important subsistence hunting areas and because of management actions to provide for sustainable harvests (subsistence harvest limits).

In 2000, about 50% of the nearly 100 households attempted to harvest moose, with about 25% successful. It is likely that Cantwell hunters would continue to try hunting in the TUA first because it is closest to them. This means as many as 50 households could use ORVs to scope for moose throughout the TUA (except recovery areas) before and during hunting season.

The advantages of hunting by snowmobile (extended season, broader access, easier loading, cleaner conditions, and easier storage of meat) would likely result in greater hunter participation, especially over the long term.

These factors could result in a return to state lands by a small minority of the hunters. However, those hunters who harvest game farther from identified trails and routes and who are willing to

use non-motorized means of retrieval would benefit from less competition. Over the long term, there would likely be an increase in subsistence activity off trail as more hunters became willing to use alternative methods of game retrieval, including horsepacking.

VI. Availability of Other Lands and Alternatives to the Proposed Action

This plan addresses management of ORV use for subsistence purposes in the Cantwell TUA. There are no other lands that can be substituted in the proposed action.

VII. Alternatives Considered

This plan includes a full range of alternatives that address ORV use for subsistence purposes in the Cantwell TUA. The range of alternatives includes a no action alternative that represents the status quo for subsistence uses.

VIII. Findings

The above evaluations demonstrate that there would be a significant restriction of subsistence resources under Alternative 1 and no significant restriction of subsistence resources or opportunities under any of the action alternatives in this plan.

Actions in Alternative 1 (No Action) would have major negative impacts because subsistence moose hunting, facilitated by unrestricted ORV access, would be above a sustainable level in the TUA. Over the long term subsistence users would have to expend more time and effort hunting on non-park lands and could be affected by increasing restrictions as well as declining wildlife populations on those lands. The level of impacts to subsistence anticipated from this alternative would eventually result in a significant restriction to subsistence resources (primarily moose).

Alternative 2 would maintain natural healthy wildlife populations, but access would be somewhat restricted, wildlife would be temporarily displaced, and competition would increase. Alternative 2 would result in minor beneficial effects to subsistence resources and opportunities because of extensive ORV access and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Enhanced access to subsistence resources and opportunities would result from identifying trails and routes for ORV use, new access to the Bull River floodplain, and the provision for ORV access for moose and caribou retrieval. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term. The identified ORV trails and routes would be in good moose habitat, so for much of the subsistence hunting season (the last half of August and the month of September) there would be more opportunities to hunt moose near trails. Counteracting these benefits, however, would be the restrictions on ORV use for retrieval and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term.

Alternative 3 would maintain natural healthy wildlife populations, wildlife would be temporarily displaced, and access would increase during winter; however access would be somewhat restricted during summer and fall, and competition would increase. Alternative 3 would result in minor beneficial impacts to subsistence resources and opportunities because of improved access

and proactive wildlife management that would provide for sustainable harvest over the next 10-15 years. Greater access to subsistence resources and opportunities would result from improvements to NPS-managed trails and routes, and new access to the Bull River floodplain. The monitoring provisions and recommended management actions in the alternative, including subsistence harvest limits for moose and caribou, would make it possible to have a sustainable harvest level over the long term and remove uncertainty for subsistence users. The identified ORV trails and routes would be in good moose habitat, so for much of the subsistence hunting season (the last half of August and the month of September) there would be more moose near trails and harvests would increase. There would also be a winter hunt extending as long as possible, which if established would provide additional subsistence opportunities. Counteracting these benefits, however, would be restrictions on ORV use and increased competition among hunters in the TUA, especially in and near the access corridors. On balance the beneficial impacts to subsistence use would be minor over the long term. For subsistence purposes Alternative 3 is recommended as the preferred management option considered in the environmental assessment because it would have the least overall negative impacts to subsistence resources and subsistence users over the long term (the next 10-15 years).

Alternative 4 would maintain natural healthy wildlife populations, competition for resources would increase, and access would increase during winter; however, access would be restricted during summer and fall, and wildlife would be temporarily displaced. Alternative 4 would result in minor adverse impacts to subsistence resources and opportunities. Access would be more difficult since ORV use would be allowed only on NPS-managed trails, and only beginning one week before the opening of hunting season. Competition among hunters in the TUA would increase, especially in and near the access corridors. However, a winter hunt would provide additional subsistence opportunities, and subsistence users would have the option of using other hunting and retrieval methods such as travel by horseback or on foot. Monitoring and proactive management, including subsistence harvest limits for moose and caribou, would provide for sustainable harvest over the next 10-15 years.

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APPENDIX 2

Monitoring Strategies for Management Alternatives

ALTERNATIVE 1 (NO ACTION)

Monitoring Impacts to Soils and Vegetation

Because the entire TUA would be open to use under this alternative, the entire existing network of trails that was mapped during 2005 would be included in the monitoring plan. Much of the rest of the accessible terrain in the TUA would also be monitored to some degree.

A three-tiered approach to monitoring would be needed under this alternative that would include periodic extensive aerial GPS-mapping surveys of the entire study area every three years, ground-based GPS mapping of the tracks in the TUA (to be done annually to a subset of the existing tracks) and in-depth annual comparisons of paired index and control impact sites. Specifically, the monitoring program should contain the following components:

1. Periodic helicopter-assisted aerial survey of the entire TUA to map the extent of ORV tracks (as was done in the spring of 2005). This would provide successive "snapshots" of the overall footprint of ORV tracks on the landscape of the TUA. These snapshots would provide the coarsest level of coverage of the area, and would be required because under this alternative the footprint of ORV impacts would be expected to potentially increase through time.

2. Annual repeat of the ground-based GPS-mapping and visual inspection activities using a data dictionary similar to the one developed for the ORV impact inventory project in 2005. (A data dictionary is the list of standardized terminology and values that may be entered into a database.) This would allow for comparisons to be made of the overall condition of trails (on a percentage basis) as well as the identification of specific track segments that are above the impact threshold levels. Only a subset of all trails could be measured each year.

3. Measurement of a set of specific "index" sites along designated routes where the actual amount of ongoing ORV use (using pressure-sensitive vehicle counters buried in the track) could be quantified in combination with detailed and time-intensive field measurements of impacts at these sites to include cover of ground surface by plant taxa using point-intercept transects, species composition measurements using quadrats, measuring soil traits including track depth, soil compaction and soil temperature.

4. Measurement of a set of high-impact "control" sites where use would be eliminated and the same set of measurements described above for the index sites would be made. The control sites (if possible) should be selected in a manner that "pairs" them with the index sites that will be subject to continued ORV traffic. This design would thus allow comparisons of multiple sets of paired impact sites, one under treatment effects (ORV traffic) and one control. The paired sites should therefore be located near each other, have similar slope, aspect, vegetation, soils, and initial impact levels.

5. Because motor vehicles would be traversing open soil areas on floodplains that are susceptible to invasion by exotic species, such as sweet clover (*Melilotus* spp.) annual visual

reconnaissance of these areas for spreading of weeds would be an important component of the monitoring program.

Monitoring Impacts to Subsistence Harvest of Moose and Caribou

To track the number of moose and caribou harvested by subsistence hunters in the TUA, the NPS would provide hunters with a reporting form when they obtain their hunting permits. Subsistence hunters will be asked to voluntarily complete the form if they kill a moose or caribou, and deposit the form in a lock-box located in Cantwell. Among other things, this form would ask for information on the harvest location of any moose or caribou a subsistence hunter killed within the TUA. In addition, the NPS would continue to periodically monitor moose and caribou populations within the TUA.

ALTERNATIVE 2

2.4.5 Monitoring Strategies

Monitoring Impacts to Soils and Vegetation

The actual spatial extent of the monitoring program under this alternative cannot be known in advance, and will be variable from year-to-year depending upon the success rate and spatial distribution of success (and consequent retrieval trips). Because of this fact, there is uncertainty regarding the amount of track outside of the designated trails and routes that would need to be monitored each year. The

A two-tiered approach to monitoring would be needed under this alternative that would include ground-based GPS mapping and visual inspection of the tracks in the TUA outside of the designated routes (to be done annually to a subset of the existing tracks) and in-depth annual comparisons of paired index and control impact sites. Specifically, the monitoring program should contain the following components:

1. A periodic repeat of the ground-based GPS-mapping activities using a data dictionary similar to the one developed for the ORV impact inventory project in 2005 that would include only the designated routes and the retrieval tracks that were traveled during each of the past three years. This would allow for comparisons to be made of the overall condition of trails (on a percentage basis) as well as the identification of specific track segments that are above the impact threshold levels. The conditions on specific retrieval tracks could then be examined and compared over time.

2. Measurement of a set of specific “index sites” where the actual amount of ongoing ORV use (using pressure-sensitive vehicle counters buried in the track) could be quantified in combination with more detailed and time-intensive measurements at these sites to include cover of ground surface by plant taxa using point-intercept transects, species composition measurements using quadrats, measuring soil traits including track depth, soil compaction and soil temperature.

3. Measurement of a set of high-impact “control” sites where use would be eliminated and the same set of measurements described above for the index sites would be made. The control sites (if possible) should be selected in a manner that “pairs” them with the index sites that will be subject to continued ORV traffic. This design would thus allow comparisons of multiple sets of paired impact sites, one under treatment effects (ORV traffic) and one

control. The paired sites should therefore be located near each other, have similar slope, aspect, vegetation, soils, and initial impact levels.

4. Because motor vehicles would be traversing open soil areas on floodplains that are susceptible to invasion by exotic species, such as sweet clover (*Melilotus* spp.) annual visual reconnaissance of these areas for spreading of weeds would be an important component of the monitoring program.

Monitoring Impacts to Subsistence Harvest of Moose and Caribou

Same as Alternative 1.

ALTERNATIVE 3

Monitoring Impacts to Soils and Vegetation

The focus of monitoring under this alternative would be limited to the specific designated trails and routes.

A two-tiered approach to monitoring would be needed under this alternative that would include ground-based GPS mapping and visual inspection of the designated trails and routes in the TUA outside and in-depth annual comparisons of paired index and control impact sites. Specifically, the monitoring program should contain the following components:

1. Periodic repeat of the ground-based GPS-mapping activities using a data dictionary similar to the one developed for the ORV impact inventory project in 2005 that would include only the designated routes in the TUA. This would allow for comparisons to be made of the overall condition of trails (on a percentage basis) as well as the identification of specific track segments that are above the impact threshold levels.

2. Identification of a set of specific "index sites" where the actual amount of ongoing ORV use (using pressure-sensitive vehicle counters buried in the track) could be quantified in combination with more detailed and time-intensive measurements at these sites to include cover of ground surface by plant taxa using point-intercept transects, species composition measurements using quadrats, measuring soil traits including track depth, soil compaction and soil temperature.

3. Measurement of a set of high-impact "control" sites where use would be eliminated and the same set of measurements described above for the index sites would be made. The control sites (if possible) should be selected in a manner that "pairs" them with the index sites that will be subject to continued ORV traffic. This design would thus allow comparisons of multiple sets of paired impact sites, one under treatment effects (ORV traffic) and one control. The paired sites should therefore be located near each other, have similar slope, aspect, vegetation, soils, and initial impact levels.

4. Because motor vehicles would be traversing open soil areas on floodplains that are susceptible to invasion by exotic species, such as sweet clover (*Melilotus* spp.) annual visual reconnaissance of these areas for spreading of weeds would be an important component of the monitoring program.

Monitoring Impacts to Subsistence Harvest of Moose and Caribou

Same as Alternative 1.

ALTERNATIVE 4

2.6.5 Monitoring Strategies

Monitoring Impacts to Soils and Vegetation

Monitoring under this alternative would be conducted in order to monitor the recovery of impacted trails and areas through time. The removal of ORV traffic would allow the nearly 50 km of ORV track impacts mapped during 2005 to recover. A variety of monitoring plots would be established to track the recovery of these areas. This would potentially provide very useful information regarding the ability of these systems to return to the natural state once this stressor is removed.

A two-tiered approach to monitoring would be needed under this alternative that would include ground-based GPS mapping and visual inspection of the designated trails and routes in the TUA outside and in-depth annual comparisons of paired index and control impact sites. Specifically, the monitoring program should contain the following components:

1. Periodic repeat of the ground-based GPS-mapping activities using a data dictionary similar to the one developed for the ORV impact inventory project in 2005 that would include only the designated routes in the TUA. This would allow for comparisons to be made of the overall condition of trails (on a percentage basis) as well as the identification of specific track segments that are above the impact threshold levels.

2. Measurement of a set of "control" sites where the recovery of vegetation and soil from ORV impacts would be monitored through time. Data from each successive iteration would be compared in order to discern the changes in these variables through time, and the degree to which each site had recovered from ORV damage.

3. Because motor vehicles would not be traversing open soil areas on floodplains that are susceptible to invasion by exotic species, such as sweet clover (*Melilotus* spp.) annual visual reconnaissance of these areas would not be necessary under this alternative, as it was for alternatives 1 through 3..

Monitoring Impacts to Subsistence Harvest of Moose and Caribou

Same as Alternative 1.

APPENDIX 3

Implementation Cost Estimates for Management Alternatives

Note: All costs are estimated ranges and are for alternative comparison purposes only. These costs should not be used for specific planning or budgeting purposes.

ALTERNATIVE 1 (NO ACTION)

Item	Cost
Management Prescriptions	N/A
Bull River Access Trail Construction	N/A
Trail Construction and Trail and Route Maintenance Within Bull River and Upper Cantwell Creek Floodplains	N/A
Monitoring Strategy (helicopter/airplane time, personnel, logistics)	$65,000 to $70,000 annually in 2006 dollars (excluding cost of pressure-sensitive vehicle counters)
Closures and Rehabilitation of Recovery Areas/Trails	$15,000 to $20,000 for materials and one-time labor in 2006 dollars
Ranger Patrols (Staff and Aircraft)	~$30,000 annually in 2006 dollars

ALTERNATIVE 2

Item	Cost
Management Prescriptions (materials, labor, administrative oversight)	$165,000 to $170,000 total in 2006 dollars
Bull River Access Trail Construction	$135,000 to $325,000 in 2006 dollars (depending on type & location of helicopter used to access site)
Trail Construction and Trail and Route Maintenance Within Bull River and Upper Cantwell Creek Floodplains	$100,000 in 2006 dollars (assuming a need for full trail construction along 2 miles of floodplains)
Monitoring Strategy (helicopter/airplane time, personnel, logistics)	$55,000 to $60,000 annually in 2006 dollars (excluding cost of pressure-sensitive vehicle counters)
Closures and Rehabilitation of Recovery Areas/Trails	$15,000 to $20,000 for materials and one-time labor in 2006 dollars
Fisheries Inventory Associated with Bull River Floodplain Trail/Route	$25,000 in 2006 dollars
Ranger Patrols (Staff and Aircraft)	~$50,000 annually in 2006 dollars

ALTERNATIVE 3

Item	Cost
Management Prescriptions (materials, labor, administrative oversight)	$165,000 to $170,000 total in 2006 dollars
Bull River Access Trail Construction	$135,000 to $325,000 in 2006 dollars (depending on type & location of helicopter used to access site)
Trail Construction and Trail and Route Maintenance Within Bull River and Upper Cantwell Creek Floodplains	$100,000 in 2006 dollars (assuming a need for full trail construction along 2 miles of floodplains)
Monitoring Strategy (helicopter/airplane time, personnel, logistics)	$30,000 to $35,000 annually in 2006 dollars (excluding cost of pressure-sensitive vehicle counters)
Closures and Rehabilitation of Recovery Areas/Trails	$15,000 to $20,000 for materials and one-time labor in 2006 dollars
Fisheries Inventory Associated with Bull River Floodplain Trail/Route	$25,000 in 2006 dollars
Ranger Patrols (Staff and Aircraft)	~$30,000 annually in 2006 dollars
Winter Patrols	$30,000 annually in 2006 dollars

ALTERNATIVE 4

Item	Cost
Management Prescriptions	$165,000 to $170,000 total in 2006 dollars
Bull River Access Trail Construction	N/A
Trail Construction and Trail and Route Maintenance Within Bull River and Upper Cantwell Creek Floodplains	N/A
Monitoring Strategy (helicopter/airplane time, personnel, logistics)	$30,000 to $35,000 annually in 2006 dollars (excluding cost of pressure-sensitive vehicle counters)
Closures and Rehabilitation of Recovery Areas/Trails	$15,000 to $20,000 for materials and one-time labor in 2006 dollars
Winter Patrols	$30,000 annually in 2006 dollars

APPENDIX 4

Draft Best Management Practices Framework

(The following is excerpted from the unpublished "Draft Proposed Best Management Practices for Off-Highway Vehicle Trails in Alaska" (NPS 2002).)

The concept of "Best Management Practices" (BMPs) is familiar for land managers in Alaska. BMPs are developed to reflect the current management "state-of-the-art" for a given activity and are designed to facilitate that activity in a manner that minimizes or mitigates detrimental impacts to other resource values such as water quality, wildlife habitat and visual resources.

The draft BMP framework for OHV/ATV trail management includes the following components:

1. "State of the Trail" Assessment
2. Trail Location Documentation
3. Trail Condition Assessment
4. Secondary Impact/Concern Assessment
5. Evaluation of Management Options
6. Formulation of Trail Management Prescriptions
7. Prescription Implementation
8. Annual "Light" Maintenance
9. Periodic Trail Monitoring and Evaluation

An associated set of proposed BMPs for technical aspects of OHV trail work include:

a) Trail Alignment and Layout Guidelines
b) Trail Construction Specification Guidelines
c) Water Crossings and Bridges
d) Sign Guidelines
e) Map Guidelines
f) Restoration Guidelines

A more detailed description of the BMP numbered components is presented below. The technical components have yet to be prepared.

1. The First Step–"State of the Trail" Assessment

The "State of the Trail" assessment is a preliminary review of the management status of an individual trail. It is based upon best available information and provides an initial handle on the management status of a trail or a group of trails. The assessment helps identify data gaps, inconsistencies in management oversight and problem trails.

2. Trail Location Documentation

Trail location documentation is the plotting of a trail alignment on a geographic referenced base. An accurate map of the trail location is a critical basic element for trail management. It provides information on trail mileage, and the relationship between the

trail alignment and surrounding environmental parameters such as terrain, landmarks, surface hydrology, etc. Coupled with a Geographic Information System (GIS) it provides an overlay for land status, landcover, wetland or other environmental data.

3. Trail Condition Assessment

Trail condition assessment is an inventory of a trail's physical conditions. It documents the condition of a trail's surface tread as it relates to soil, terrain and vegetation conditions. A condition assessment documents trail conditions at a given point in time. It provides a baseline for monitoring changes and identifies problems with trail conditions that might require repair or mitigation.

4. Secondary Impact/Concern Assessment

Secondary impact assessments document impacts of OHV trail use that are not directly related to the physical trail tread. These may include administrative, social, biologic and other physical resource impacts or concerns. A secondary impact analysis requires both an investigation along the trail corridor with a multi-disciplinary team and discussions with trail users, local residents and trail managers. To date, no one has developed a set format for the secondary assessment.

5. Evaluation of Management Options

The trail condition and secondary impact/concern assessments provide a basis to evaluate trail management options. The evaluation of management options should take place within the context of local zoning requirements and/or or land management plans or objectives for the trail and the lands surrounding it.

The range of trail management options include:

a). Active Management of the Existing Alignment
b). Realignment of Degraded Trail Segments
c). Trail Hardening of Degraded Segments
d). Seasonal Use Restrictions
e). Type of Use Restrictions
f). Controlled Use (traffic volume control)
g). Trail Closure

The trail management options can be applied to entire trails, or to individual trial segments. Management options a, b and c would typically be applied in combination along a trail alignment, while options d, e, f and g would be applied to an entire trail or to a major segment of trail beyond some natural geographic feature such as a seasonally sensitive wetland.

6. Formulation of Trail Maintenance Prescriptions

Trail maintenance prescriptions identify where trail maintenance and/or mitigation actions are required. Prescriptions define where reroutes and trail hardening need to be installed and where active management actions such as ditching, brush control, water management and crossing structures are required. They describe where and what work needs to be done, and provide an excellent base for cost estimates.

7. Prescription Implementation (Construction and Heavy Maintenance)

Prescription implementation is conducting planned trail maintenance or mitigation based upon prepared trail maintenance prescriptions. The term "Heavy Maintenance" is used here to distinguish this work from "Light" maintenance sweeps that should occur on an annual basis without specified prescriptions.

8. Annual "Light" Maintenance Sweeps

"Light" maintenance sweeps should occur on an annual basis. These sweeps should be targeted at preventing minor trail problems from developing into major trail problems. The sweeps should be used to conduct routine maintenance actions such as cleaning culverts, reshaping water control features and dealing with other minor trail problems such as fallen trees and damaged signs. Inspections should also be made of bridges. Maintenance crews should also document developing problems and may be used to collect annual monitoring data. The sweeps should also be used to identify the development of major problems that might require a more formal maintenance prescription and heavy maintenance action.

9. Periodic Trail Monitoring and Evaluation

Detailed monitoring should be completed every four to six years, depending on levels of use, trail conditions and environmental factors. This frequency could be increased if significant environmental values are at risk, but sufficient time should be allowed so that the changes in trail condition are evident over seasonal and weather effects, and the subjectivity of field inventory crews. It is also important that the same trail condition inventory system be employed between condition inventories so direct relationships can be evaluated.

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APPENDIX 5

Trail Management Prescriptions

Newly Constructed Bull River Access Trail

	Specific Type of Action	Linear Feet
Newly Constructed Bull River Access Trail (8,512 linear feet total length)		
Trail Hardening	2-Inch Geoblock	54
	Puncheon-Ground Contact	148
Surface Grubbing	Light Grubbing	3,407
	Moderate Grubbing	2,804
	Heavy Grubbing	771
Bridges	Wooden Deck (2 bridges)	60 (total)
Clearing	Light Clearing	3,752
	Moderate Clearing	3,872
	Heavy Clearing	611
Cut and Fill	< 15% Side Slope	25
	15-45% Side Slope	1,287
	45-100% Side Slope	369
Fill on Flat	--	5

Gravel for fill material would be generated during construction activities from bench cuts or from using a slot inversion construction method (i.e., digging a shallow trench into underlying gravel along the alignment, backfilling with surface organics, and using the excavated gravel to top-cap the trail surface). Some of the excavated gravel may be transported short distances along the trail alignment for use as fill, but most would be incorporated into the bench or side-cast down slope. No gravel pits or long-term stockpiles would be developed.

Other than the distinct bench cut areas and slot inversion segments, most of the trail would be simply roughed in by knocking down the high spots and hummocks and using them to fill in the low spots, and by compacting the surface vegetation to provide a distinct trail alignment that would be further worn in with use. Drainage would be provided along the alignment using grade reversals and slot drains (shallow excavated swales that cross the trail and drain water well below the trail alignment).

Low puncheon-style bridges consisting of Alaskan cedar stringer and decking (totaling 60 feet) would be built across two streams, but no part of the bridges would be placed in the stream channels. In addition, there would be two small stream/spring crossings and two improved fords. The fords would be improved by cutting the banks slightly to allow ORVs easy access to and from the streams; if the stream banks or beds show any sign of potential erosion from ORV use, a hardened surface would be installed consisting of geogrid placed at grade and filled with native material (soil or gravel).

Existing Identified Trail Management Prescriptions

	Specific Type of Action	Linear Feet
Windy Creek Access Trail (4,639 linear feet total length)		
General Action	Maintain	4,284
	Upgrade	355
Trail Hardening	1-Inch Geoblock	355
	None Required	4,284
Surface Grubbing	Light Grubbing	355
	None Required	4,284
Windy Creek Bowl Trail (4,340 linear feet total length)		
General Action	Close/Barricade	1,708
	Maintain	2,632
Rehabilitation	Full Rehabilitation	1,708
	None Required	2,632
Cantwell Airstrip Trail (7,757 linear feet total length)		
General Action	Maintain	7,614
	Upgrade	143
Trail Hardening	1-Inch Geoblock	165
	2-Inch Geoblock	33
	Elevated Puncheon	67
	Ground Contact Puncheon	76
	None Required	7,416
Surface Grubbing	Light Grubbing	101
	Moderate Grubbing	97
	None Required	7,559
Pyramid Peak Trail (5,148 linear feet total length)		
General Action	Maintain	4,660
	Upgrade	488
Trail Hardening	Elevated Puncheon	488
	None Required	4,660
Clearing	Moderate Clearing	406
	None Required	4,742

Trail hardening with Geoblock (a porous pavement system) or puncheon (a type of elevated boardwalk) would bring treated segments to a "sustainable" level due to the resistant character of the treated tread surface. A “sustainable” trail segment is one that meets a specific set of design criteria formulated to provide a high level of environmental protection and long-term utility of the tread surface under all anticipated use levels and climatic conditions; *and* receives regular maintenance to remain within its original design specifications.

The implementation of surface grubbing (to dig up and remove all plants), clearing, grading, cut and fill, side-ditching, selected water control measures and gravel capping would bring treated segments to a "maintainable" level. A “maintainable” trail segment is one that is not built with a specific set of design criteria in-mind, but with appropriate and reasonable mitigation and maintenance, it will support a limited level of use without unacceptable environmental degradation or a decrease in travel surface utility.

Implementation of the recommended management prescriptions for the above NPS-managed existing trails would result in improvement of about 1,100 linear feet to a “sustainable” level, with the remaining approximately 21,000 linear feet of NPS-managed trail system brought to or staying at a “maintainable” level.

17B Easement Management Prescriptions

	Specific Type of Action	Linear Feet
17B Easement (8,868 linear feet total length)		
General Action	Close/Barricade	830
	Maintain	2,242
	Upgrade	654
	Upgrade/Rebuild	5,141
Grading	Heavy Grading/Leveling	591
	Light Grading/Leveling	2,584
	Moderate Grading/Leveling	1,258
	None Required	4,435
Trail Hardening	1-Inch Geoblock	178
	2-Inch Geoblock	140
	2-Inch Geoblock with Geotextile	67
	Gravel Cap	364
	Gravel Camp with Geotextile	277
	Elevated Puncheon	142
	Turnpike Sideditch	703
	Turnpike with Cross Drain	498
	None Required	6,498
Capping D	4-8 Inches	114
	8-12 Inches	528
	None Required	8,226
Surface Grubbing	Light Grubbing	95
	Moderate Grubbing	554
	None Required	8,219
Clearing	Light Clearing	232
	None Required	8,636
Side Ditching	Both Sides	732
	Left Side	2,819
	Right Side	1,446
	None Required	3,871
Rehabilitation	Full Rehabilitation	830
	None Required	8,037
Water Management	Light Water Management	69
	None Required	8,798
Cut/Fill Sections	Fill on Flat	50
	None Required	8,818

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APPENDIX 6

STATEMENT OF FINDINGS FOR EXECUTIVE ORDER 11990 (PROTECTION OF WETLANDS)

CANTWELL SUBSISTENCE ORV MANAGEMENT DENALI NATIONAL PARK AND PRESERVE, ALASKA

May 2007

Recommended:

_____

Superintendent, Denali National Park and Preserve Date

Certified for Technical Accuracy and Servicewide Consistency:

_____

Chief, Water Resources Division, Washington Office Date

Approved:

_____

Regional Director, Alaska Region Date

PURPOSE AND NEED FOR ACTION

The National Park Service (NPS) has prepared and made available for public review an environmental assessment (EA) to evaluate the impacts of a management plan for subsistence ORV use in the Cantwell Traditional Use Area in Denali National Park and Preserve.

In July 2005, the NPS published the final "Cantwell Subsistence Traditionally Employed Off-Road Vehicle Determination" which opened the entire 32,159 acre Cantwell traditional ORV use area (TUA) to the use of off-road vehicles (ORVs), for subsistence purposes by NPS qualified subsistence users. The NPS is taking this current action to assure subsistence ORV use in this area is proactively managed to minimize adverse impacts to the resources and values for which the park was established while also providing reasonable access for subsistence purposes.

Under the preferred alternative (Alternative 3) the NPS is proposing to construct a new Bull River Access Trail and Bull River and Cantwell Creek Floodplain Trails, harden and maintain the Windy Creek Access Trail, the Windy Creek Bowl Trail, the Pyramid Peak Trail, and the Cantwell Airstrip Trail. ORV access would also be allowed on the upper gravel bars of the Bull River and Cantwell Creek floodplains downstream of the park wilderness boundary. At the same time, the park would initiate maintenance on the ANCSA 17b easement created to allow public access across Native Corporation land between Cantwell and the park boundary.

Executive Order 11990 (Protection of Wetlands) requires the NPS, and other federal agencies, to evaluate the likely impacts of actions in wetlands. The executive order requires that short and long-term adverse impacts associated with occupancy, modification or destruction of wetlands be avoided whenever possible. Indirect support of development and new construction in such areas should also be avoided wherever there is a practicable alternative.

To comply with these orders, the NPS has developed a set of agency policies and procedures which can be found in Director's Order 77-1: Wetland Protection, and Procedural Manual 77-1: Wetland Protection. The policies and procedures related to wetlands emphasize: exploring all practical alternatives to building on, or otherwise affecting, wetlands; reducing impacts to wetlands whenever possible; and providing direct compensation for any unavoidable wetland impact by restoring degraded or destroyed wetlands on other NPS properties.

The purpose of this Statement of Findings (SOF) is to present the NPS rationale for its proposed plan to construct portions of the TUA trails in the wetland area. This SOF also documents the anticipated effects on these resources.

WETLANDS WITHIN THE PROJECT AREA

Wetland boundaries were identified in the field by NPS personnel and the boundaries were transferred to 2005 air photos and transferred to a GIS layer by NPS staff to determine wetland acreage. Wetlands are identified in Figure 3.2 of the EA, and compensation and mitigation bank acreages are shown in Figure 8.1. Areas of identified open trails that cross wetland areas would be improved to minimize negative impacts and trail width. Wetlands would be affected on approximately 0.4 acres of existing trails due to construction actions used to harden the trails and make them sustainable for ORV use. Approximately 1 acre of the new floodplain trails alignments would be in wetlands of the willow floodplain type. About 0.1 acres of wetlands would be affected by construction of a new Bull River Access Trail and about 250 acres of

unvegetated gravel floodplain would be open for ORV use. Approximately 5.8 acres of upland would also be affected by this proposal.

The wetlands located within the proposed project area consist of wet scrub-shrub and forested saturated wetlands.

- To construct the Bull River Access Trail, 0.1 acres of Palustrine scrub shrub saturated wetlands (PSS1) are to be disturbed. The 1.0 acres of floodplain willow areas to be disturbed to delineate and harden the Cantwell Creek and Bull River Floodplain Trails are also PSS1 wetlands.

- The 0.4 acres of wetlands crossed by the 4 retained ORV trails that will be hardened and maintained under this alternative are Palustrine Forested, Needle-leaved Evergreen, saturated wetlands (PF04B).

All of the Palustrine wetlands provide habitat for small mammals, such as red squirrels, snowshoe hares, and porcupine; bird species, including gray jays, robins, thrushes, sparrows, and warblers. Caribou use the shrub wetlands for forage and cover, and moose also frequent the shrub wetlands for forage. The forested type is considered potential moose calving area, to be used as cover.

The major plant species on the Palustrine wetland sites include willow spp., including *Salix planifolia*, blueberry, Labrador tea, and white spruce in the forested areas. Common ground cover includes feather and sphagnum mosses in the forested areas, leaf lichens, and a variety of forbs. The palustrine wetlands attenuate snow melt surface flow during break-up, when the ground is still frozen.

All of the constructed and retained trails will have culverts or armored fords installed for all minor stream crossings to reduce or eliminate adverse impacts to water quality from the project. This is estimated to reduce the contribution of turbidity from trail construction and use to negligible within four years.

The two proposed floodplain trails would include 21 stream crossings (19 on Cantwell Creek and 2 on the Bull River) at places without culverts or constructed bed armoring connecting sections of trail crossing palustrine floodplains. The impacts of the turbidity release from ORV use at these crossings would be virtually unmeasurable during most of the summer due to the heavy bedload already carried by these glacial rivers. During September - the latter part of the moose hunting season – the rivers run clear unless there are heavy rains, and the turbidity from ORV use would be measurable for a short distance downstream. The flora and fauna of the two main streams, however, are adapted to long periods of turbid water and to common irruptions of turbidity in September, whether from groups of caribou crossing the creek or from heavy rains.

- The 250 acres of unvegetated gravel floodplain that would be open for ORV user route-finding are Riverine Upper Perennial Streambed Gravels (R3SB3).

The unvegetated gravel bars aid in surface water retention by delaying the release of water from the gravels, with the impact depending on the depth of the gravels. Caribou use the unvegetated floodplains as travel corridors and to find a bit of a breeze on insect-filled days.

The Cantwell Creek and Bull River Routes are areas of unvegetated gravel bars proposed for unrestricted subsistence ORV use. The gravel bars of those glacial rivers are very mobile and the

channels change size and pattern by the hour during much of the summer and the rivers usually carry a heavy bedload. Turbidity inputs from ORV use at that time of year would have a negligible effect on water quality. During September the turbidity from ORV use might be measurable for a short distance downstream, but the turbidity increase would not reach far downstream due to the large average grain size upstream and to the expected low intensity of use. Macroinvertebrate and other aquatic resources are generally lacking in the gravel bar sections of the rivers due to the annual scouring by the heavy bedload. No threatened or endangered animal or plant species are found in the area and no research or reference sites have been developed in the project area. No water supply points or wells are located downhill between the project sites.

The forested and scrub shrub wetland types described above are common throughout the eastern areas of Denali National Park and Preserve. The unvegetated gravel bars are common to all of the glacially fed rivers originating in the Alaska Range core of the park, and the impacts to the gravel-covered floodplains would be temporary as the evidence would be swept away by river channel changes and ice formation each year. The park has determined that the vegetated wetlands proposed to be affected the construction and use of ORV trails comprise a relatively minor part of the large acreages of local and park wetlands, and that filling, or otherwise disturbing the wetlands within the trail alignments by vegetation control, would have a minor impact on surface water quality, including sediment control and water purification, surface water retention and animal habitat.

THE PROPOSAL IN RELATION TO WETLANDS

The proposal and alternatives are described in detail in the project EA and else where in this Statement. Wetlands are identified in Figure 3.2 of the EA. Existing impacts to all vegetation types are identified in Figure 3.1.

The construction of new ORV trails and the retention of 4 other trails in the Cantwell TUA will impact a maximum of 1.5 acres of wetlands, in addition to 250 acres of unvegetated floodplain gravels that would be open for ORV travel. The statutory authorization for local rural residents to use vehicles on park lands for subsistence purposes, where traditionally employed, is limited by existing regulations at 36 CFR 13.460, and by the assignment by Congress to require the “appropriate use” of the vehicles. The trails and use envisioned in this alternative would allow substantial vehicle access to all of the lowlands within the TUA for hunting and other subsistence uses, in addition to the provision to set up an over the snow winter hunt to allow additional access to reach places perhaps farther away from the trail network.

Discharge of dredged or fill material into jurisdictional wetlands is regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. The project would affect wetlands under the jurisdiction of the Corps and the Corps is being consulted regarding the necessary compliance.

MITIGATION PROPOSED

Federal and NPS Policy is to avoid siting projects in wetlands whenever possible. If circumstances make it impracticable to avoid wetlands, then mitigation of unavoidable impacts must be planned. A NPS wetlands no-net-loss policy requires that wetland losses be compensated for by restoration of wetlands, preferably of comparable wetland type and function and in the same watershed (if possible).

The existing use by ORVs on 21.6 acres of wetlands would be eliminated under this proposal. These sites range from open wetlands to forested wetlands. Active restoration would occur on 0.4 acres of wetlands. Of the 8.2 acres affected by continuing or new actions under the proposal, 1.5 acres are classified as wetlands. This SOF commits to full 2:1 compensation for the 1.5 acres of disturbed wetlands.

On-Site Rehabilitation

Any areas disturbed by construction activities would be restored to as near natural conditions as possible. Prior to the start of construction activities, the NPS would salvage as much topsoil, organic matter, and vegetation as necessary for later use in site revegetation or for use in revegetating other local sites. Salvaged material would be stockpiled separately and would be placed in the disturbed areas following construction.

Off-Site Compensation (Wetland Restoration)

Compensation, by restoration of previously disturbed degraded wetlands, is required under the NPS no-net-loss policy for projects involving disturbance or loss of wetlands. Compensation will occur for the loss of 1.5 acres of palustrine and forested wetland. Two-for-one compensation will be completed by allowing 3.0 acres of formerly degraded trails through forested and open wetlands in the Cantwell TUA to naturally reclaim. Of the 1.5 acres of wetlands to be disturbed by this project, 0.4 acres are forested wetlands (PFO4B) and 1.1 acres are scrub shrub wetlands (PSS1). Wetlands removed from ORV use as compensation will include 0.4 acres of forested wetlands affected by the Windy Creek North Trail, and 0.4 acres of woodland wetlands affected by the Cantwell Northwest Trail. Compensation for palustrine wetlands loss will come from closing 2.2 acres of open wetlands affected by the Cantwell Creek West-Southeast Trail (see Figure 8.1 in this Appendix). The 3 acres of compensation area will not require active restoration and are expected to recover as fully functional wetlands within 5-20 years through withdrawal from ORV use. In addition to the 3 acres used for compensation, an additional 18.6 acres of degraded wetlands will also be closed to further ORV use. This acreage will be put into the NPS Alaska Wetland Mitigation Bank, to be used as compensation for proposed projects that would impact wetlands in the .

ALTERNATIVES CONSIDERED

Alternative 1 - Under the No Action Alternative off-trail and on-trail ORV use would be allowed for all subsistence purposes by NPS qualified subsistence users throughout the Cantwell Traditional Use Area (TUA). There would be no limits on the types of ORVs that could be used. The NPS would continue to monitor the impacts of ORV use in the TUA. However, unlike under Alternatives 2, 3, and 4, the NPS would not establish specific degradation levels to aid in determining when management action is needed. The pre-existing 17b easement through Ahtna Inc. property in the Windy Creek area near Cantwell would continue to be managed as it has in the past for the following uses: travel by foot, dogsleds, animals, snowmobiles, two- and three-wheel vehicles, and small all-terrain vehicles (ATVs) (less than 3,000 pounds gross vehicle weight). Impacts to wetlands could occur anywhere on the 2,314 acres of mapped wetlands within the TUA, as there would not be any limits to ORV use for subsistence purposes. The NPS feels that this alternative would lead to impairment of the vegetation and wetlands resources of the park.

Alternative 2 - Under Alternative 2, parts of 4 existing ORV trails would be retained and maintained, two floodplain ORV trails would be constructed as necessary, the Bull River Access Trail would be constructed, and the 17b easement would be managed and maintained for mixed light use, including use by ORVs. ORVs would be allowed to travel off-trail to retrieve an expected 8 moose and 4 caribou per hunting season, with areas closed to ORV use that are steeper than a 20% slope and which are mapped as saturated soils (i.e., open wetlands, low-shrub/open wetland mix, ravines and stream corridors, willow swamp, open water). This alternative is not the preferred alternative due to the major impacts to wetlands expected from the use of ORVs off-trail to retrieve moose and caribou.

Alternative 3, the NPS preferred alternative, is described above.

Alternative 4 describes a plan to retain only parts of the four existing trails, as mentioned above in the description of the preferred alternative. There would be no new trail construction and 0.4 acres of wetlands would be affected by trail hardening and other drainage-related improvements. Use on the floodplain trails would not be allowed and the Bull River Access Trail would not be built. The 17b easement would be managed and maintained for mixed light use, including use by ORVs. Even though this alternative provides the least impacts to the environment, it is not chosen as the preferred because it does not provide reasonable access into the two major lowlands of the TUA – Cantwell Creek and Bull River floodplains – during the traditional and customary time of year for hunting large game, and makes packing meat out at that time of year very difficult.

SUMMARY OF ENVIRONMENTAL CONSEQUENCES ASSOCIATED WITH THE PROPOSED ACTION

The potential environmental consequences of the proposed action and alternative are fully described in the EA.

CONCLUSION

The NPS concludes that the statutory requirement to allow the appropriate use of ORVs for subsistence purposes within the Cantwell TUA means that a reasonable ORV access management plan has to be devised. The NPS feels that constructing new trails and maintaining existing trails that lead to all the major lowlands within the TUA is an allowance that provides for resource protection as well as reasonable access for vehicles which are not generally allowed into the backcountry of NPS areas. Alternatives 1 and 2 would create extensive resource damage and cannot be approved with a Finding of No Significant Impact. Alternative 4 does not provide reasonable access to two of the three major lowland areas within the TUA during the traditional and customary time of year for hunting large game, and makes packing meat out at that time of year very difficult. Wetlands would be avoided to the maximum practicable extent. The wetland impacts that could not be avoided would be minimized. The NPS acknowledges that some natural localized wetlands processes would unavoidably be lost by the trails constructed or maintained under this proposal. Impacts on the 1.5 acres of wetlands would be compensated for, on a minimum 2-for-1 acreage basis, by closing existing ORV trails in the TUA with damaged wetlands. Degraded wetlands on 18.6 acres will be closed to further ORV use. This acreage will be put into the NPS Alaska Wetland Mitigation Bank, to be used as compensation for proposed projects that would impact wetlands in the future. The NPS finds that this project is consistent with the Procedural Manual #77-1, *Wetland Protection* and with NPS Director's Order #77-1, *WetlandProtection*. The NPS finds that this project is in compliance with Executive Order 11990, *Wetland Management*.

APPENDIX 7

DENALI NATIONAL PARK AND PRESERVE MINIMUM REQUIREMENTS DECISION GUIDE

The Minimum Requirements Decision Guide (MRDG) is a process to identify, analyze, and select management actions that are the minimum necessary for wilderness administration. It applies direction from the Wilderness Act and incorporates a two-step process. Step 1 determines whether administrative action is necessary. If action is found to be necessary, then Step 2 provides guidance for determining the ***minimum*** activity. Step 2 has been referred to as determining the minimum tool but could include any type of activity, method, or equipment.

The MRDG can be used as:

- a process for evaluation and documentation;
- a guide to help discuss proposals with interested parties; or
- a review of on-going management practices to determine if they are necessary or if a less intrusive practice can be implemented.

The MRDG is designed to assist with preparation of a NEPA analysis, if needed, but is not a substitute for a NEPA analysis. Portions of the MRDG may be transferable to a subsequent NEPA analysis.

Agency NEPA guidelines do not necessarily require a process to determine if administrative action in wilderness is necessary or to select the administrative activity that causes the least adverse effect to the wilderness resource and character. The MRDG provides a method to determine the necessity of an action and how to minimize impacts; NEPA analysis compares and discloses the environmental effects of alternatives, documents a decision, and requires public involvement.

WORKSHEETS

". . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act..."

– the Wilderness Act, 1964

Step 1: Determine if any administrative action is <u>necessary</u>.

Description: Briefly describe the situation that may prompt action.

The National Park Service (NPS) is considering alternatives for managing subsistence-related off-road vehicle use in the Cantwell Traditional ORV Use Area. In July 2005, the NPS published the final "Cantwell Subsistence Traditionally Employed Off-Road Vehicle Determination" which opened the entire Cantwell traditional ORV use area (TUA) to the use of off-road vehicles (ORVs), for subsistence purposes by NPS qualified subsistence users. The NPS is taking this current action to assure subsistence ORV use in this area is managed to minimize adverse impacts to resources and values for which the park was established while also providing reasonable access for subsistence purposes. The 1980 Alaska National Interest Lands Conservation Act (ANILCA)

authorizes subsistence uses where traditional in the ANILCA additions of Denali National Park (Denali additions) by local rural residents. ANILCA also provides for reasonable access with methods of surface transportation traditionally used for subsistence purposes.

To help determine if administrative action is necessary, answer the questions listed on the following pages.

A. Is the situation an emergency that demands immediate action?

Explain: No

B. Describe valid existing rights or special provisions of wilderness legislation

Are there valid existing rights or is there a special provision in wilderness legislation (the Wilderness Act of 1964 or subsequent wilderness laws) that allows consideration of action involving Section 4(c) uses? Cite law and section.

Explain: Section 811 ANILCA provides for reasonable access for subsistence on public lands and the appropriate use of the methods of surface transportation traditionally employed for subsistence purposes. These provisions allow motorized equipment or mechanical forms of transportation in wilderness for subsistence purposes, subject to reasonable regulation to prevent adverse impacts to other resources, values or other purposes of the unit.

C. Describe requirements or special provisions of other legislation

How are other applicable laws for the unit relevant to the need for resolution of the situation?

Explain: None that are directly applicable to the decision on whether the proposed activity is appropriate within the park or on lands that have been determined to be suitable for designation. ANILCA provides the primary direction on this matter.

D. Describe other guidance

How does taking action conform to and implement relevant standards and guidelines and direction contained in agency policy, unit and wilderness management plans, species recovery plans, tribal government agreements, state and local government and interagency agreements that have received appropriate level of NEPA review?

Explain: Motorized transportation in support of subsistence use in this specific case is an allowable activity. However, the allowance is conditional. Section 811 allows for appropriate use. It can be regulated to prevent adverse impacts to other resources, values or other purposes of the unit.

E. Describe options outside of wilderness

Can the necessary information be obtained or the situation resolved by an administrative activity outside of wilderness?

Explain: The area of traditional use is within the park. Subsistence use within that area is legally appropriate and has been requested by the local users. As a result, the NPS is required to evaluate the possibility of use within the park.

F. Describe how resolving the situation is related to the purpose of the Act

Is action to resolve the situation necessary to accomplish the purpose of the Act which is: "…to secure for the American people of present and future generations the benefits of an enduring resource of wilderness"?

As applicable, explain how resolving the situation will conflict or be consistent with the direction in the Act to administer the area in a way that provides for:

1) The use and enjoyment of the public in such a manner as will leave it unimpaired for future use and enjoyment as wilderness (see #2 for factors that define wilderness)

2) The protection of the wilderness area and its wilderness character, considering such factors that define the wilderness and contrast it from other public lands such as

- "untrammeled",
- "undeveloped",
- "…outstanding opportunities for solitude or a primitive and unconfined type of recreation…",
- "natural conditions",
- "…ecological, geological, or other features of scientific, educational, scenic, or historical value…." that are specific to the area

3) The gathering and dissemination of information regarding the area's use and enjoyment as wilderness (see #2 for factors that define wilderness)

Explain: There is not an inherent conflict with these factors within the limited context of the exceptions established by ANILCA for the type of access being considered. The degree to which there will be conflict with these factors is dependent upon how the use is allowed and managed. Like any other form of ground transportation, even hiking, ORV use has the potential to adversely impact a number of the factors listed above if it occurs at inappropriate locations or levels.

Step 1 Decision: Is any administrative action necessary?

An affirmative answer to one or more of the previous questions is required to proceed to Step 2 to determine the minimum activity.

Yes: x No:
Yes, provided Step 2 shows no compromise of wilderness character ☐
More information needed: ☐

Provide a summary explanation: Yes, a specific and legally valid request to evaluate the use of ORVs to support subsistence purposes within the TUA has been received by the NPS. The NPS is required to conduct an evaluation to determine the effects of different management approaches

that could be used to provide for that activity while still being consistent with other direction to prevent adverse impacts to the resources, values and other purposes of the unit.

Step 2: Determine the minimum activity.

Description of Alternatives

For each alternative, describe what methods and techniques will be used, when the activity will take place, where the activity will take place, what mitigation measures are necessary, and the general effects to the wilderness resource and character.

Alternative # 1

Description: See description of the alternative as provided in Chapter 2 of the Environmental Assessment.

Effects: (Select and consider as appropriate for your situation) See effects as described in Chapter 4 of the Environmental Assessment.

Alternative # 2

Description: See description of the alternative as provided in Chapter 2 of the Environmental Assessment.

Effects: (Select and consider as appropriate for your situation) See effects as described in Chapter 4 of the Environmental Assessment.

Alternative # 3

Description: See description of the alternative as provided in Chapter 2 of the Environmental Assessment.

Effects: (Select and consider as appropriate for your situation) See effects as described in Chapter 4 of the Environmental Assessment.

Alternative # 4

Description: See description of the alternative as provided in Chapter 2 of the Environmental Assessment.

Effects: (Select and consider as appropriate for your situation) See effects as described in Chapter 4 of the Environmental Assessment.

Step 2 Decision: What is the Minimum Activity?

The selected alternative is: Alternative 3 (modified).

The alternative that is most compatible with the wilderness resource is Alternative 3 with modifications. It is the same as Alternative 3 with the exception that a trail would not be constructed to the Bull River and ORV use would not be allowed on the Bull River floodplain.

The effects of this modification can be derived from the discussions for Alternative 3 and Alternative 4 in Chapter 4 or the Environmental Assessment.

Describe the rationale for selecting this alternative: This modification to Alternative 3 represents the best balance between the legal obligation to provide for reasonable access and the equally important responsibility for preventing unnecessary adverse impacts to other resources and values. The alternative provides for substantial ground access to the majority of the TUA, particularly the areas where there is the best evidence of actual use prior to 1980. It does so without the construction of new access trails into areas where there is negligible evidence of current or past use. Reasonable access is provided to those areas by alternative methods with fewer impacts such as a winter hunt. This modified Alternative 3 confines all use to trails or routes on maintainable surfaces. This makes it consistent with other policy and regulatory direction for ORVs that suggests the use should be confined rather than allowed to disperse. By not adding new trails, the alternative retains the level of trail formation that was present in the TUA at the time the wilderness suitability review was conducted for the area.

In contrast, both alternative 1 and 2 allow for the continued development of random crosscountry damage from ORVs. Alternative 3 expands ORV use into areas that have negligible evidence of past or current use. Alternative 4 reduces ORV access below the level which was occurring in 1980 and makes winter travel the primary means of access in the area. This may not meet the test of reasonable access.

Alternative 3 (modified) is the minimum action that can be taken while still meeting the requirement to provide for ORV use on park lands, particularly those that have been found to be suitable for wilderness designation.

Describe any monitoring and reporting requirements: See Chapter 2 of the Environmental Assessment

Please check any Wilderness Act Section 4(c) uses approved in this alternative:

- x mechanical transport
- x motorized equipment
- ☐ motor vehicles
- ☐ motorboats
- ☐ landing of aircraft
- ☐ temporary road
- ☐ structure or installation

Be sure to record and report any authorizations of Wilderness Act Section 4(c) uses according to agency procedures.

Approvals	Signature	Name	Position	Date
Prepared by:	/s/ Joe Van Horn	Joe Van Horn	Wilderness Program Coordinator	3/15/07
Approved:		Paul Anderson	Superintendent	

APPENDIX 8

Vegetation in the Traditional Use Area

The following two tables provide detailed information about the vegetation in the Traditional Use Area. The first table, Vegetation Types and Classifications, quantifies the linear and area impacts on the vegetation map classifications depicted on Figure 3.2 Vegetation in the Traditional Use area. This first table also translates the map classifications to Cowardin and Viereck classifications. The second table, Vegetation Description and Distribution, provides the same quantitative information as the first table, but also describes the characteristics and general location of the vegetation in the TUA.

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
Wetlands				
		Note:	Proportions of lengths to areas are sometimes disparate (for example, a short length but a large area) because of the GIS methodology used to obtain total lengths and total areas of ORV impacts by vegetation type. Distances are based on the center of the ORV travel path (a theoretical line of no width) going *through* a vegetation type, while areas are based on a trail or impacted areas' ~~s~~ impact width *overlapping* a vegetation type. Thus because many trails and impacted areas are at the edge of a vegetation type (frequently wetlands such as willow swamps), few have their center of travel through them but do often have their impacted areas overlapping adjacent vegetation.	

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
Open wetlands		11.3 miles, 19.5 acres	Acidic and basic wetlands, dominated by herbaceous plants or bryophytes, typically with little to no shrub vegetation, saturated soils or inundated ground. Mapped as a single unit (3a) including the variations below.	
3a.1. Open herbaceous-bryophyte wetlands	yes	Included in above.	**PEM1**; palustrine emergent persistent, **PML1**; palustrine moss-lichen moss.	**III.A.3.j**; subarctic lowland sedge-bog meadow.
3a.2. Wet sedge (*Carex* spp.) meadows	yes	Included in above.	**PEM1**; palustrine emergent persistent vegetation.	**III.A.3.c**; wet sedge herb-meadow tundra.
3a.3. Floating mat bogs	yes	Included in above.	**PML1**; palustrine moss-lichen moss.	**III.B.3.c**; subarctic lowland herb bog meadow.
3a.4. Sedge-sphagnum bog	yes	Included in above.	**PML1**; palustrine moss-lichen moss.	**III.A.3.k**; subarctic lowland sedge-moss bog meadow.
3a.5. Open wetland edge transition meadows	yes	Included in above.	**PEM1**; palustrine emergent persistent.	**III.B.3.b**;subarctic lowland herb wet meadow.

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
Shrubbed wetlands			Acidic and basic wetlands, with shrub component and saturated soils or inundated ground.	
3b. Willow swamps	yes	5.9 linear feet, 301.4 square feet	**PSS1**; palustrine scrub-shrub wetland broad-leaved deciduous.	**II.B.1.f**, closed tall shrub swamp, **II.B.2.f**, open tall shrub swamp.
3c. Low shrub wetlands	yes	491.2 linear feet, 5726.4 square feet	**PSS1**; palustrine scrub-shrub broad-leaved deciduous, **PEM1**; palustrine emergent wetland persistent.	**II.C.2.i**, open low willow-graminoid shrub bog.
River floodplains, streams, and ponds			Complex mosaic of mainly wetland systems due to high water table, frequent flooding, and disturbance regimes. Frequent swales and wet meadows, willow swamps and wet shrublands, and occasionally open peatlands. Often occupy very small areas and transition abruptly into different systems. Some floodplain areas on Windy Creek support small stands of spruce forest, which appears to be rather similar to the wet spruce-willow type further upland in the same area.	
Floodplain vegetation		3054.5 linear feet, 10021.2 square feet	Mapped as a single unit (8a) including the variations below.	

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
8a.1. Floodplain willow swamps	yes	Included in above.	As map classification 3b, above.	
8a.2. Wet floodplain swales	yes	Included in above.	**PUS5**; palustrine unconsolidated shore vegetated	
8a.3. Wet floodplain shrublands	yes	Included in above.	**PSS1**; palustrine scrub-shrub wetland broad-leaved deciduous.	**II.B.1.a**; closed tall willow shrub, **II.B.2.a**; open tall willow shrub, and occasionally **II.B.1.d**; closed tall alder-willow shrub.
8a.4. Open floodplain peatlands	yes	None seen on this type.	As map classification 3a.1 and 3a.2, above.	
2a. Ravines and stream corridors	yes	3301.2 linear feet, 1.04 acres	Closest to map classification 3b, above, but often with flowing water.	

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
0. Open waters	yes	4.3 linear feet, 1991.3 square feet) (probably more but traces not seen)	**R3OW**; Riverine upper perennial open water & **R3RB2**; riverine upper perennial rock bottom rubble (Cantwell & Windy Creeks, Bull R.), **R4SB**; riverine intermittent streambed (various subclasses; streams dissecting TUA), **POW** & **PUB4**; palustrine open water/unconsolidated bottom organic, **L2** (occ. **1**); lacustrine littoral (rarely limnetic) of various classes (open waters of larger ponds).	No classification.
8b. Lightly vegetated gravel bars	some	195.9 linear feet, 2400.3 square feet	**R3RS**; riverine upper perennial rocky shore.	**III.B.1.a**; seral herbs.
Shrublands			Shrublands occupy the greatest area of vegetation below alpine rock areas in the TUA, and is the "matrix" which surrounds other vegetation types. Two distinctive and quite different types are discussed here; willow (and/or alder)- and dwarf birch-dominated shrublands. Most overland travel in the TUA requires extensive transit across shrublands.	
Dwarf birch shrublands			Normally occur on better-drained areas than willow.	

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
1b. Dwarf birch shrublands	no	3.9 miles, 5.5 acres	none (non-wetland).	**II.C.1.a**; closed low shrub birch shrub, and **II.C.2.f**; open low shrub birch-willow shrub.
1c. Dwarf birch-gravel-mineral soil	no	None seen on this type	none (non-wetland).	**II.C.2.c**; open low mesic shrub birch-ericaceous shrub.
Willow and alder shrublands		3.0 miles, 4.5 acres	Several variants based on willow or alder content and soil wetness. Transition to dwarf birch in better-drained areas and to open wetlands in poorly-drained areas; most wetlands have a border of willow shrub on their margins. Approximately 25% of the area in class 4 can be designated by Cowardin classification as wetlands. Willow is also the dominant vegetation in shrub swamps, shrubbed open wetlands and sedge meadows, ravine bottoms, and ravine and floodplain slopes. Mapped as a single unit (4) including the variations below.	
4.2. Willow shrublands	some	Included in above.	(Wet areas only) **PSS1**; palustrine scrub-shrub wetland broad-leaved deciduous.	**II.B.1.a**; closed tall willow shrub, **II.B.2.a**; open tall willow, **II.C.1.b**; closed low willow, **II.C.2.g**; open low willow.
4.3. Willow-alder shrublands	some	Included in above.	(Wet areas only) **PSS1**; palustrine scrub-shrub wetland broad-leaved deciduous.	Depending on density of cover: **II.B.1.d**; closed tall alder-willow shrub, **II.B.2.d**; open tall alder-willow shrub.

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
4.4. Alder shrublands	some	Included in above.	**PSS1**; palustrine scrub-shrub wetland broad-leaved deciduous.	**II.B.2.b**; open tall alder shrub, **II.B.1.b**; closed tall alder shrub.
2b. Vegetated floodplain slopes	no	13.5 m 55 m2(44.3 linear feet, 592 square feet)	none (non-wetland).	Similar to map classification for 4.2 and, less commonly, 1b.
Woodlands			Wooded areas are of particular significance to ORV travel because the dense vegetation can limit availability of routes, including those around degraded areas.	
Spruce woodlands			Woodlands with black spruce (*Picea mariana)* are common in poorly-drained areas, and white spruce (*Picea glauca)* in more moderately-drained areas of the TUA. The soil and hydrology conditions of spruce woodlands are similar to their analogous shrublands (willow, alder, dwarf birch), and these woodlands normally transition to their analogous shrubland types at their edges.	
5. Willow and alder-spruce woodlands	some	2.3 miles, 3.5 acres	(Wet areas only) **PFO4**; palustrine forested needle-leaved evergreen.	Depending on main species: **I.A.2.e**; open white spruce forest, **I.A.2.f**; open black spruce, **I.A.2.g**; open black spruce-white spruce.
1a. Dwarf birch-spruce woodlands	no	1601.4 linear feet, 19256.6 square feet	none (non-wetland).	**I.A.2.e**; open white spruce forest.

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
Aspen woodlands				
7. Aspen groves	no	None seen on this type	none (non-wetland).	**I.B.1.e**; closed quaking aspen forest.
Meadows and open areas		1.15 miles, 1.6 acres	Primarily herbaceous, graminoid, or low shrub vegetation with few or no trees. Mapped as a single unit (6a) including the variations below.	
6a.1. Upland graminoid meadows	no	Included in above.	none (non-wetland).	**III.A.2.a**; bluejoint meadow and III.A.2.b; bluejoint-herb meadow.
6a.2. Subalpine herb meadows	no	Included in above.	none (non-wetland).	**III.A.2.b**; bluejoint meadow and **III.B.2.a**; mixed herbs.
6a.3. Alpine meadows	no	Included in above.	none (non-wetland).	**II.D.2**; (with various level IV modifiers), **III.A.1/2** (various level IV and V modifiers).

Vegetation Types and Classifications				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Cowardin classification(s)**	**Viereck classification(s)**
6b. Tussock meadows	no	None seen on this type.	none (non-wetland).	**III.A.2.d**; tussock tundra.
6c. Rock outcrop opening	no	0.12 miles,2153 square feet	none (non-wetland).	Closest to **II.D.2.b**; *Vaccinium* dwarf shrub tundra, but also some characters of **II.D.2.a**; bearberry dwarf shrub tundra. Apparently higher *Empetrum* component than above two types.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
Wetlands				

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
		Note:	Proportions of lengths to areas are sometimes disparate (for example, a short length but a large area) because of the GIS methodology used to obtain total lengths and total areas of ORV impacts by vegetation type. Distances are based on the center of the ORV travel path (a theoretical line of no width) going *through* a vegetation type, while areas are based on a trail or impacted areas' impact width *overlapping* a vegetation type. Thus because many trails and impacted areas are at the edge of a vegetation type (frequently wetlands such as willow swamps), few have their center of travel through them but do often have their impacted areas overlapping adjacent vegetation.	
Open wetlands		11.3 miles, 19.5 acres	Acidic and basic wetlands, dominated by herbaceous plants or bryophytes, typically with little to no shrub vegetation, saturated soils or inundated ground. Mapped as a single unit (3a) including the variations below.	
3a.1. Open herbaceous-bryophyte wetlands	yes	Included in above.	String bogs, floating mat bogs, and similar systems. Relatively deep saturated organic soils. In many areas, particularly the flanks of string bogs, exposed soils have little or no vegetative cover.	Common between Cantwell Creek and Bull River; frequent near Windy Creek; scattered north of Cantwell Creek. Most occupy lower concave areas.
3a.2. Wet sedge (*Carex* spp.) meadows	yes	Included in above.	Soils saturated to wet, and often thinner than those of open wetlands. Sedge meadows tend to be smaller than the open wetlands, though some larger areas are found.	Common throughout the area.
3a.3. Floating mat bogs	yes	Included in above.	Floating organic mats of sedge and sphagnum peat occurring around open water.	Only seen in the western area in 2005 fieldwork.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
3a.4. Sedge-sphagnum bog	yes	Included in above.	Open sedge-sphagnum wetland was found Soils were not observed because of heavy moss cover, but are of probably saturated peat. *Pinguicula villosa* was seen commonly in the heavy moss cover.	North of Cantwell Creek and possibly in other areas such as between Bull River and Cantwell Creek.
3a.5. Open wetland edge transition meadows	yes	Included in above.	Transition zone of meadow-type herbaceous vegetation several meters wide between hydric wetland vegetation and shrublands. Normally with wet to saturated soils, sedges, and forbs such as *Polygonum* spp., *Thalictrum alpinum*, *Parnassia* spp., *Sanguisorba officinalis*, and others.	Surround many open wetlands. Mainly western TUA, particularly between Cantwell Creek and Bull River.
Shrubbed wetlands			Acidic and basic wetlands, with shrub component and saturated soils or inundated ground.	
3b. Willow swamps	yes	5.9 linear feet, 301.4 square feet	Willow shrub areas with mostly inundated soils and >1.5m, rather dense cover of willow or alder. Differs from willow shrublands in presence of standing water.	Common, particularly in the western third of the area.
3c. Low shrub wetlands	yes	491.2 linear feet, 5726.4 square feet	Relatively open sedge dominated low shrub wetlands with low (<1m), dispersed (less than 50%) cover of willow. Represent possibly a transition stage from open wetland to shrubland. Differs from open wetlands in presence of shrub component.	Common, particularly west of the bend in Cantwell Creek and in the western third of the area.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
River floodplains, streams, and ponds			Complex mosaic of mainly wetland systems due to high water table, frequent flooding, and disturbance regimes. Frequent swales and wet meadows, willow swamps and wet shrublands, and occasionally open peatlands. Often occupy very small areas and transition abruptly into different systems. Some floodplain areas on Windy Creek support small stands of spruce forest, which appears to be rather similar to the wet spruce-willow type further upland in the same area.	
Floodplain vegetation		3054.5 linear feet, 10021.2 square feet	Mapped as a single unit (8a) including the variations below.	
8a.1. Floodplain willow swamps	yes	Included in above.	Often have very dense shrub growth over inundated thin organic soils. Similar to more upland willow swamps except for floodplain hydrological regime and substrate.	Common on backwater areas of floodplains. Most common on the Cantwell Creek floodplain.
8a.2. Wet floodplain swales	yes	Included in above.	Older channels supporting communities of plants uncommon above the floodplain, including *Pinguicula vulgaris;* some better-drained areas have developed into small sedge meadows.	

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
8a.3. Wet floodplain shrublands	yes	Included in above.	With the exception of their floodplain hydrology and somewhat different substrate (higher and variable water table, fluvial rounded gravels and sands, areas of organic soils, ridge and trough microtopography), the non-inundated floodplain shrublands are vegetationally similar to those in wetter areas above the floodplain, and are discussed under shrublands, below.	Willow swamps as described above are also common in backwater and swale areas of floodplains.
8a.4. Open floodplain peatlands	yes	None seen on this type.	Open peat wetlands only develop where floodplain sufficiently wide and hydrology stable enough for their gradual formation through time. One example at the north end of Cantwell Creek in the TUA, where a series of beaver dams has blocked drainage from uplands and created a large complex of floating mat bog, willow swamp, and open water.	Near north end of Cantwell Creek in the TUA. Rare on floodplains.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
2a. Ravines and stream corridors	yes	3301.2 linear feet, 1.04 acres	Ravines dissect the landscape at regular intervals, transmitting drainage from upslope mountain areas toward the rivers, but also occasionally connect or drain to or from wetlands. In the former case they often form steep sided, deep (to 10m or more) ravines, while in the latter they are usually shallower; often with beaver dams and/or a vegetation that is a cross between open wetland and stream valley systems. Slopes are usually eroded alluvium or glacial deposits, often with active slides. Most ravine bottoms have a poorly-sorted mixture of organic and mineral soils with some rocks and boulders with a willow or alder cover and various pools and stream widenings and meanders. Ravine slope vegetation is similar to that of river floodplain slopes.	Common on all areas of the TUA; particularly between Cantwell Creek and Bull River.
0. Open waters	yes	4.3 linear feet, 1991.3 square feet) (probably more but traces not seen)	Open waters include ponds, rivers, and streams; of these the communities at their margins are more important to this document than the open water itself. Open wetlands and wet shrublands are usually found at water margins; these and the wetland characteristics of river floodplains and streams are discussed above.	Mostly western TUA; rare elsewhere in TUA.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
8b. Lightly vegetated gravel bars	some	195.9 linear feet, 2400.3 square feet	<50% vegetated (not bare) gravel; active vegetation succession with dispersed small shrubs and herbs. Likely represent areas of the floodplain that have been deposited in recent years but with little disturbance since, and thus are undergoing succession. Typically have dispersed herbaceous vegetation and small willows with mainly open gravels.	Cantwell Creek and Bull River floodplains; small areas on Windy Creek.
Shrublands			Shrublands occupy the greatest area of vegetation below alpine rock areas in the TUA, and is the "matrix" which surrounds other vegetation types. Two distinctive and quite different types are discussed here; willow (and/or alder)- and dwarf birch-dominated shrublands. Most overland travel in the TUA requires extensive transit across shrublands.	Shrublands are found from lowest to highest areas in the TUA, and across the area.
Dwarf birch shrublands			Normally occur on better-drained areas than willow.	

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
1b. Dwarf birch shrublands	no	3.9 miles, 5.5 acres	Distributed from river floodplain slopes to alpine shrub areas on landscape mosaics with wetland matrix; most often on small knolls or ridges between open wetlands or willow shrublands on raised (thus better drained and more durable) mesic mineral soils with thin organic or humus layer. Often on moraines, drumlins, eskers, and alluvial features. In western TUA between Cantwell Ck. and Bull R. much of the landscape dominated by alternating linear wetlands and dwarf birch on higher ridges, and many alluvial fans throughout TUA occupied by dwarf birch. Occasionally intermixed with to 50% willow, depending on soil moisture; most areas of dwarf birch are adjacent to areas of willow on lower ground. A very few areas of saturated soils with dwarf birch seen in field between Bull River and Cantwell Creek.	All TUA; least common near Windy Creek. Also found on subalpine slopes, and occasionally on lower, wetter hummocky shrublands and even on some shrubbed wetland areas between Cantwell Creek and Bull River; though such areas normally transition to willow in areas of wetter soils.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
1c. Dwarf birch-gravel-mineral soil	no	None seen on this type	Distinctive dwarf birch vegetation type with small admixture of willow on a sparsely vegetated ground surface with approximately 30-50% open *Cladina* lichen covered ground; apparently on very well-drained coarse soils and gravels of old alluvial fans. Not observed on ground, but noted on satellite and helicopter photography in several areas of the western TUA; sufficiently unique to classify separately.	Several areas near Bull River; apparently ancient downcut alluvial fans with gravel. Also alluvial fans near north tip of Cantwell Creek.
Willow and alder shrublands		3.0 miles, 4.5 acres	Several variants based on willow or alder content and soil wetness. Transition to dwarf birch in better-drained areas and to open wetlands in poorly-drained areas; most wetlands have a border of willow shrub on their margins. Approximately 25% of the area in class 4 can be designated by Cowardin classification as wetlands. Willow is also the dominant vegetation in shrub swamps, shrubbed open wetlands and sedge meadows, ravine bottoms, and ravine and floodplain slopes. Mapped as a single unit (4) including the variations below.	Throughout TUA from floodplains to approximately 3000 feet elevation.
4.2. Willow shrublands	some	Included in above.	Occur on large areas of TUA from wet to mesic soils. Vary greatly in shrub height and density of cover, and thus match several Viereck types.	Willow ubiquitous on lower & wetter terrain, at the margins of wetlands, and on older floodplain areas; often forming very dense thickets.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
4.3. Willow-alder shrublands	some	Included in above.	As above, but with admixture of alder.	Eastern TUA at all elevations, western TUA at higher elevations and small areas in lower elevations.
4.4. Alder shrublands	some	Included in above.	Dense thickets of primarily alder. Upland alder shrublands are considerably denser here than equivalent sites north of the Alaska Range (Roland and Van Horn 2004).	Primarily between upper elevation woodlands and alpine; also lower elevations on saturated organic soils.
2b. Vegetated floodplain slopes	no	13.5 m 55 m2(44.3 linear feet, 592 square feet)	Normally vegetated on more stable areas with willow, willow-alder, less commonly dwarf birch on shallower slopes; otherwise similar to Viereck types referenced. Generally not wet or saturated. Soil development is minimal or absent on many slopes, and drainage is high. Often on steep slopes with erosional gullies or slope failures; some slopes have minimal successional vegetation or partially open areas where slopes have eroded or slipped.	Along Cantwell Creek and Bull River; mostly forested on Windy Creek (type 5).
Woodlands			Wooded areas are of particular significance to ORV travel because the dense vegetation can limit availability of routes, including those around degraded areas.	

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
Spruce woodlands			Woodlands with black spruce (*Picea mariana)* are common in poorly-drained areas, and white spruce (*Picea glauca)* in more moderately-drained areas of the TUA. The soil and hydrology conditions of spruce woodlands are similar to their analogous shrublands (willow, alder, dwarf birch), and these woodlands normally transition to their analogous shrubland types at their edges.	Common on middle and lower elevations to approximately 2600-3000 feet. More frequent to east; largely absent north and west of curve in Cantwell Creek.
5. Willow and alder-spruce woodlands	some	2.3 miles, 3.5 acres	Typically have a shrub layer of willow and increasing admixture of alder in wetter areas or higher elevations; alder common in wet wooded areas north of Cantwell Creek and the east side of TUA. In many areas these transition into willow or alder shrublands, open wetlands, dwarf birch-spruce woodlands, and occasionally upland meadows, depending on local conditions.	Spruce woodlands are most common in the southeastern and eastern areas of the TUA.
1a. Dwarf birch-spruce woodlands	no	1601.4 linear feet, 19256.6 square feet	On upland areas with better drainage; more productive than willow woodlands because of higher soil temperatures and increased nutrient availability. Transition to dwarf birch shrublands in drier areas; willow-type woodlands and shrublands in wetter areas; and occasionally to open wetlands or upland meadows. With admixture or mosaic of to 50% willow.	Common on better-drained upland sites including moraines, drumlins, and alluvial features in the eastern two thirds of the TUA.

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
Aspen woodlands				
7. Aspen groves	no	None seen on this type	Aspen (*Populus tremuloides*) woodlands are generally less than several hundred meters in any dimension. Aspen woodlands have relatively open, well-drained conditions with a mesic herbaceous understory.	Rare in TUA, though a few small groves occasional in dry or mesic early successional sites near upper Bull River, on the north side of Cantwell Creek, and near Windy Creek.
Meadows and open areas		1.15 miles, 1.6 acres	Primarily herbaceous, graminoid, or low shrub vegetation with few or no trees. Mapped as a single unit (6a) including the variations below.	
6a.1. Upland graminoid meadows	no	Included in above.	Mesic upland meadows on mineral soils dominated by grasses such as *Calamagrostis* and *Poa.* At least some of these areas appear to be on very old alluvial fans and thus higher, better-drained ground.	On some middle elevation slopes. They are found mainly to the north of Cantwell Creek on shallow southeast-facing slopes.
6a.2. Subalpine herb meadows	no	Included in above.	At or above treeline; have a robust growth of lush graminoid-forb meadows dominated by *Lupinus nootkatensis*, *Veratrum viride*, *Geranium erianthum*, *Heracleum lanatum*, and *Carex* spp, as a result of moister growing conditions.	Appears to be distributed throughout the TUA at around treeline (appx. 3000').

Vegetation Description and Distribution				
Map Classification	**Wetland?**	**Impact in TUA, linear and area**	**Description**	**Distribution**
6a.3. Alpine meadows	no	Included in above.	Most often dominated by Rosaceae, Ericaceae, Salicaceae family dwarf shrubs with graminoids and forbs. Large amount of geomorphological disturbance and relatively young age of surfaces; many slopes essentially barren, supporting only a few scattered cushion plants.	Throughout TUA at or above treeline.
6b. Tussock meadows	no	None seen on this type.	Appears on satellite and helicopter photography as open herbaceous tussock meadows. Not investigated on the ground, but appear to be dominated by graminoids and some herbs with scattered willow shrubs.	Several areas located primarily along Bull River and a few areas between Bull River and Cantwell Creek.
6c. Rock outcrop opening	no	0.12 miles,2153 square feet	Comprised of xerophytic woody and herbaceous plants such as *Empetrum nigrum*, *Arctostaphylos*, *Arnica*, *Lycopodium selago*, *Cladina* spp., *Dryas*, *Saxifraga*, *Campanula lasiocarpa*, and *Epilobium latifolium* on poorly formed thin soils over bedrock outcrops. Extent of this vegetation type unknown; was **not delineated on satellite-interpreted vegetation mapping** for this project. In some ways it resembles higher alpine vegetation.	Only one location field surveyed, west of Cantwell and traversed by the Cantwell Airstrip trail at about 2600' elevation, surrounded by dwarf birch-type vegetation. Possibly more widespread in area.

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